Washington State Military Department

Emergency Management Division:

Can the Tohoku, Japan Earthquake & Tsunami Happen Here?

John Schelling, Program Manager

- **www.emd.wa.gov**

Presentation Overview

- Summary of March 11 Tohoku Earthquake & Tsunami
- Washington State Emergency Management's Earthquake/Tsunami Program
- The U.S. Tsunami Warning System and WA EMD's role

CREDIT(S): This presenter graciously thanks and acknowledges Mr. Atsushi Koresawa, Asian Disaster Reduction Center (ADRC), Dr. Yasuo Kawawaki, International Recovery Platform (IRP), Mr. Masahiro Yamamoto (UNESCO) for all text and graphics related to Tohoku EQ/Tsunami Overview.

Summary of the March 11 earthquake

Date and Time:

11 March 2011 at 14:46 JST (5:46 GMT)

Type of earthquake:

Plate-boundary thrust-faulting earthquake on or near the Japan Trench Subduction zone

Hypocenter:

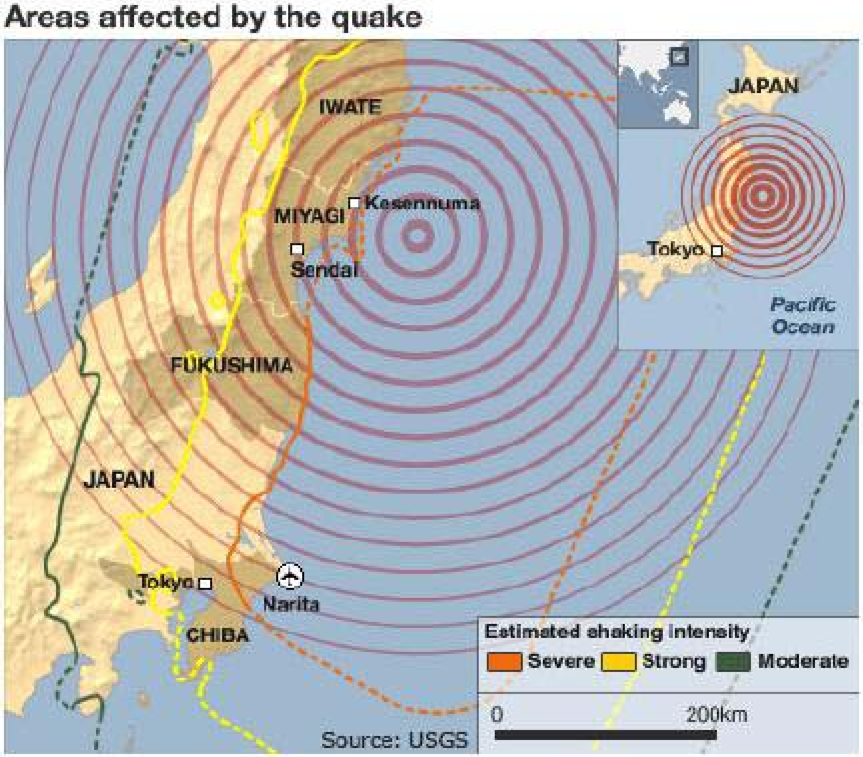
130km off the Pacific coast of Tohoku region (38°N, 142°E), 24km depth

Magnitude:

9.0 (interim value, the largest in Japan and the 4th largest in the world)
c.f. 2004 Sumatra Earthquake M9.1

Damage:

The destruction of social infrastructure, housing and corporate facilities would cost between 16 and 25 trillion yen (Cabinet Office’s estimate)



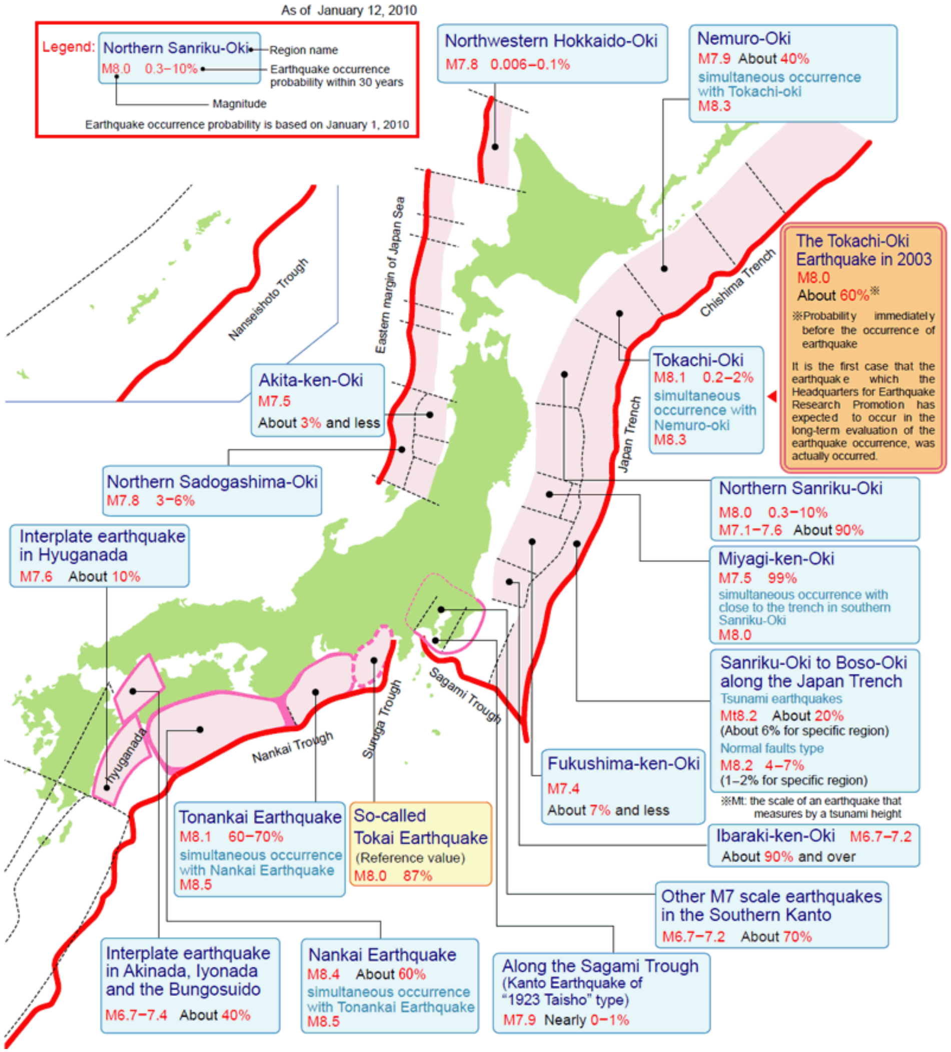
Areas affected by the quake

Source: USGS

Source: OCHA Situation Report No.1

Main characteristics of the March 11 earthquake

- The areas hit by the earthquake and tsunami along Pacific Sea coast were known to be vulnerable to tsunami as they were recurrently hit by tsunami.
  - Large offshore earthquakes occurred in the same subduction zone in 1611, 1896 and 1933 and each of them caused devastating tsunami on the coast.
- Large inter-plate earthquakes had been predicted to occur in this region with 99% probability within thirty years and the magnitudes ranging from M7.5 to M8.0.
- The March 11 earthquake was much bigger than the prediction, recording M9.0 and the rupture zone stretched 500 km length and 200 km width.
  - Some experts say that the earthquake was the one by a thousand year return period.

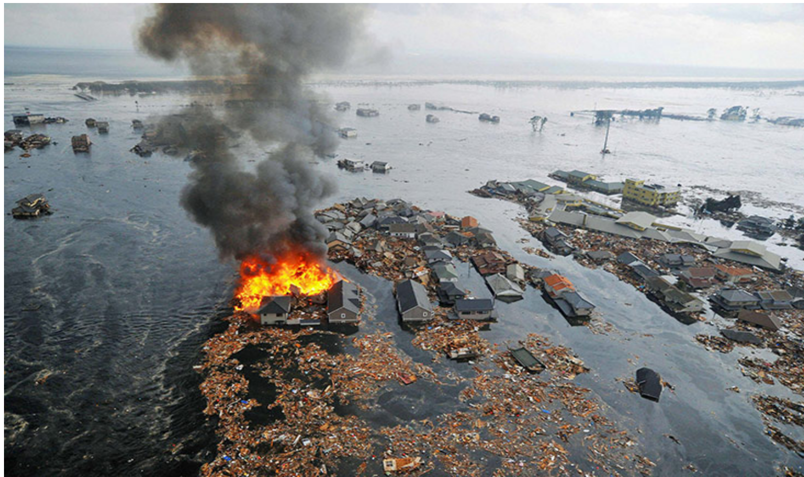

As of January 12, 2010
Legend: Northern Sanriku-Oki — Region name
M8.0 0.3–10% — Earthquake occurrence probability within 30 years
Magnitude
Earthquake occurrence probability is based on January 1, 2010
Northwestern Hokkaido-Oki M7.8 0.006–0.1%
Nemuro-Oki M7.9 About 40% simultaneous occurrence with Tokachi-oki M8.3
The Tokachi-Oki Earthquake in 2003 M8.0 About 60%※
※Probability immediately before the occurrence of earthquake
It is the first case that the earthquake which the Headquarters for Earthquake Research Promotion has expected to occur in the long-term evaluation of the earthquake occurrence, was actually occurred.
Chishima Trench
Nanseishoto Trough
Eastern margin of Japan Sea
Akita-ken-Oki M7.5 About 3% and less
Tokachi-Oki M8.1 0.2–2% simultaneous occurrence with Nemuro-oki M8.3
Japan Trench
Northern Sadogashima-Oki M7.8 3–6%
Northern Sanriku-Oki M8.0 0.3–10% M7.1–7.6 About 90%
Interplate earthquake in Hyuganada M7.6 About 10%
Miyagi-ken-Oki M7.5 99% simultaneous occurrence with close to the trench in southern Sanriku-Oki M8.0
Sanriku-Oki to Boso-Oki along the Japan Trench
Tsunami earthquakes Mt8.2 About 20% (About 6% for specific region)
Normal faults type M8.2 4–7% (1–2% for specific region)
※Mt: the scale of an earthquake that measures by a tsunami height
Sagami Trough
Suruga Trough
Nankai Trough
Hyuganada
Fukushima-ken-Oki M7.4 About 7% and less
Ibaraki-ken-Oki M6.7–7.2 About 90% and over
Tonankai Earthquake M8.1 60–70% simultaneous occurrence with Nankai Earthquake M8.5
So-called Tokai Earthquake (Reference value) M8.0 87%
Other M7 scale earthquakes in the Southern Kanto M6.7–7.2 About 70%
Interplate earthquake in Akinada, Iyonada and the Bungosuido M6.7–7.4 About 40%
Nankai Earthquake M8.4 About 60% simultaneous occurrence with Tonankai Earthquake M8.5
Along the Sagami Trough (Kanto Earthquake of "1923 Taisho" type) M7.9 Nearly 0–1%

Casualties

- The number of casualties continues to rise. The Government has confirmed 13,498 people have died and 14,734 are still missing (as of April 14, 2011).

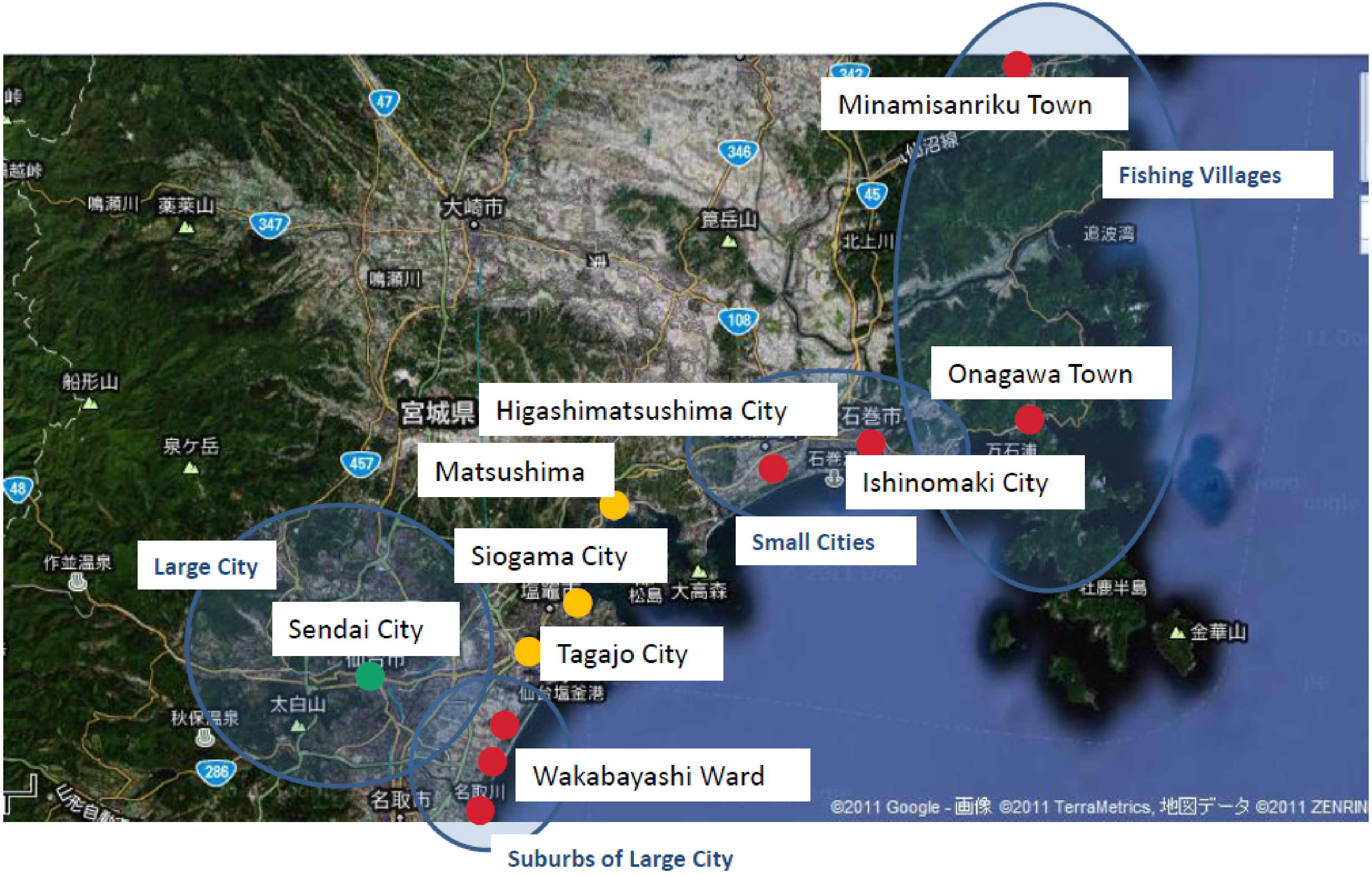
- It has already exceeded that the 1995 Great Hanshin Awaji (Kobe) Earthquake.

  The number of people who are missing covers only those who have been reported to the police by their families or acquaintances. It is likely that there are still thousands of people missing that are uncounted.

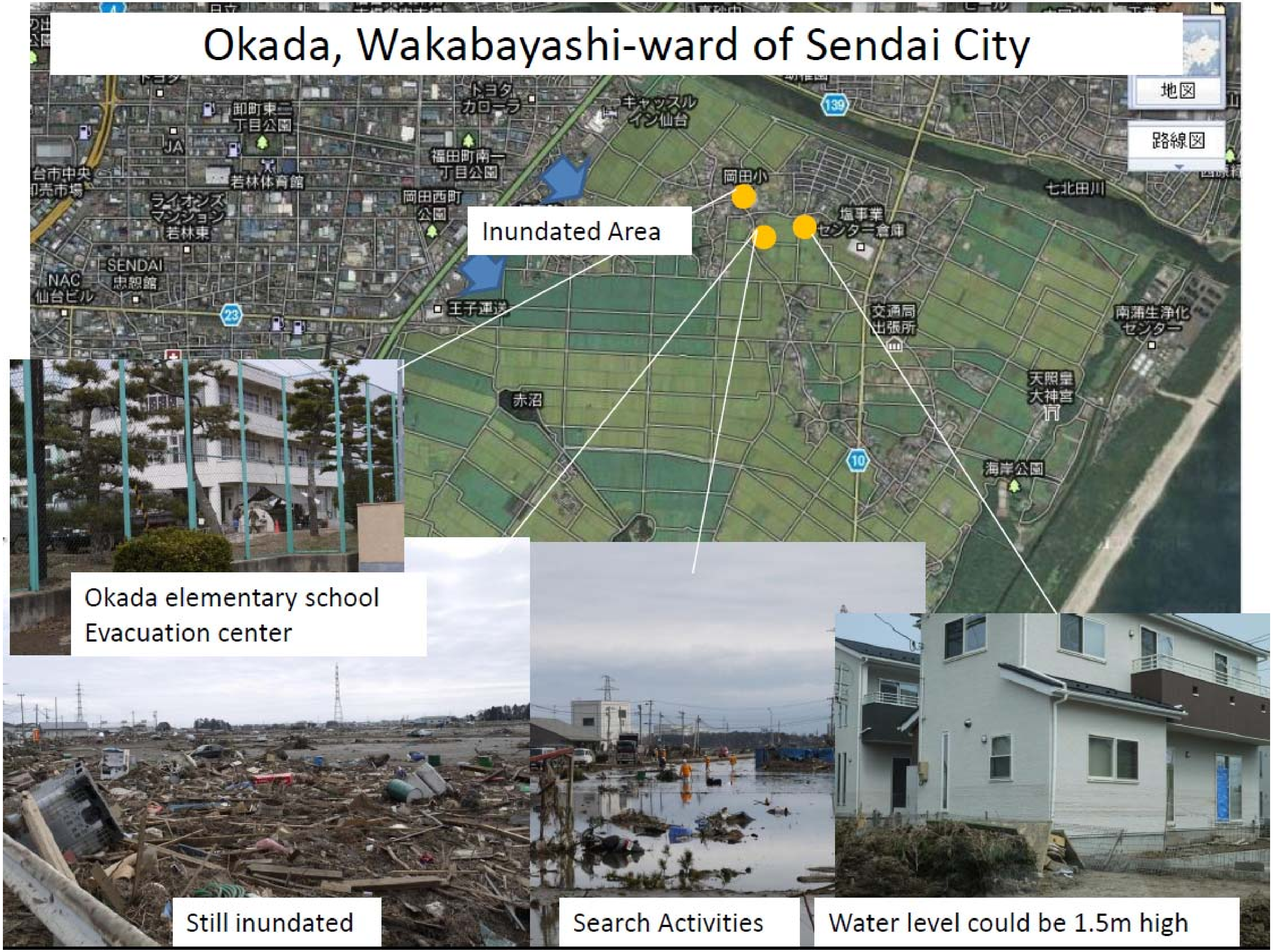


- The number of refugees once topped 30 thousand, but it has been decreasing as the situation stabilized and services and utilities and services gradually restored

Areas Surveyed



Okada, Wakabayashi-ward of Sendai City



Inundated Area

Okada elementary school
Evacuation center

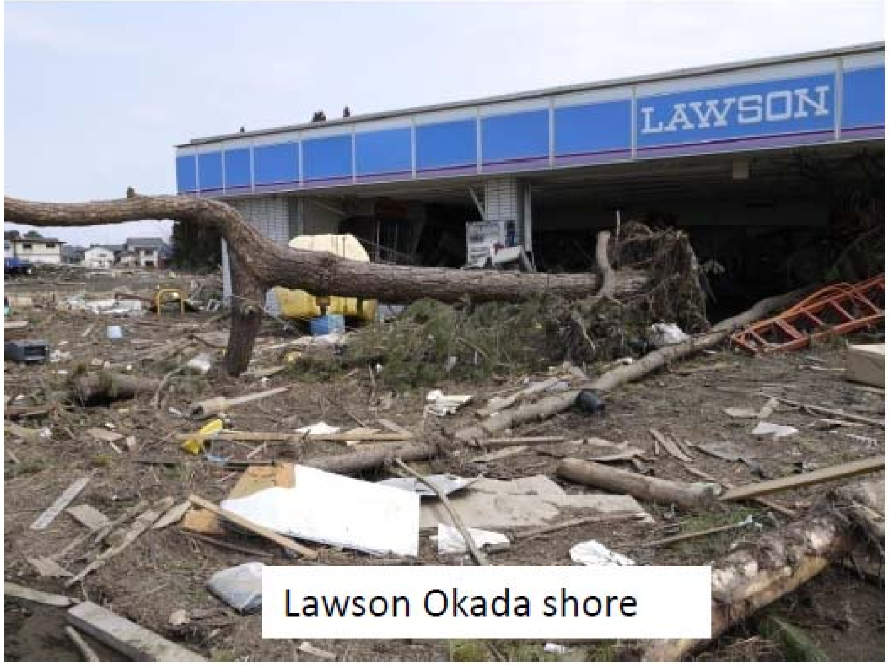
Still inundated

Search Activities

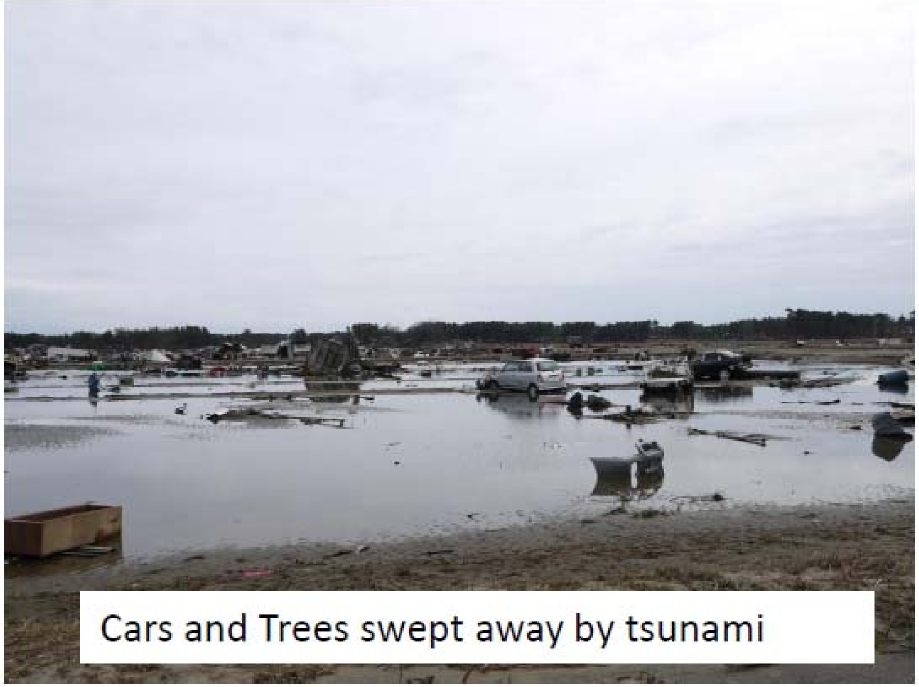
Water level could be 1.5m high

Okada, Wakabayashi-ward Sendai City

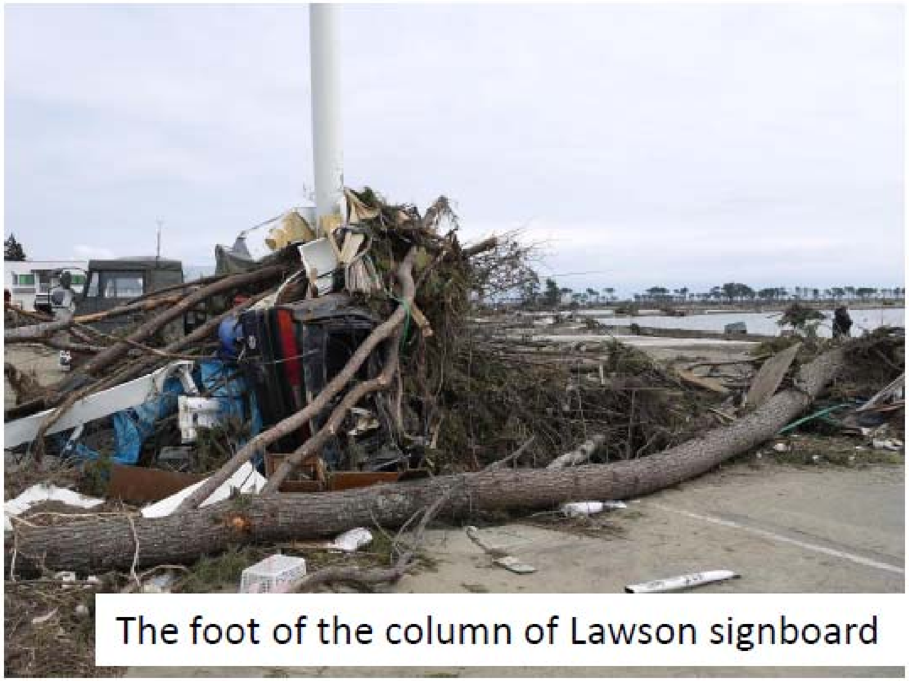
Along the road (Rout Shiogama-Watari) near the seashore



Lawson Okada shore

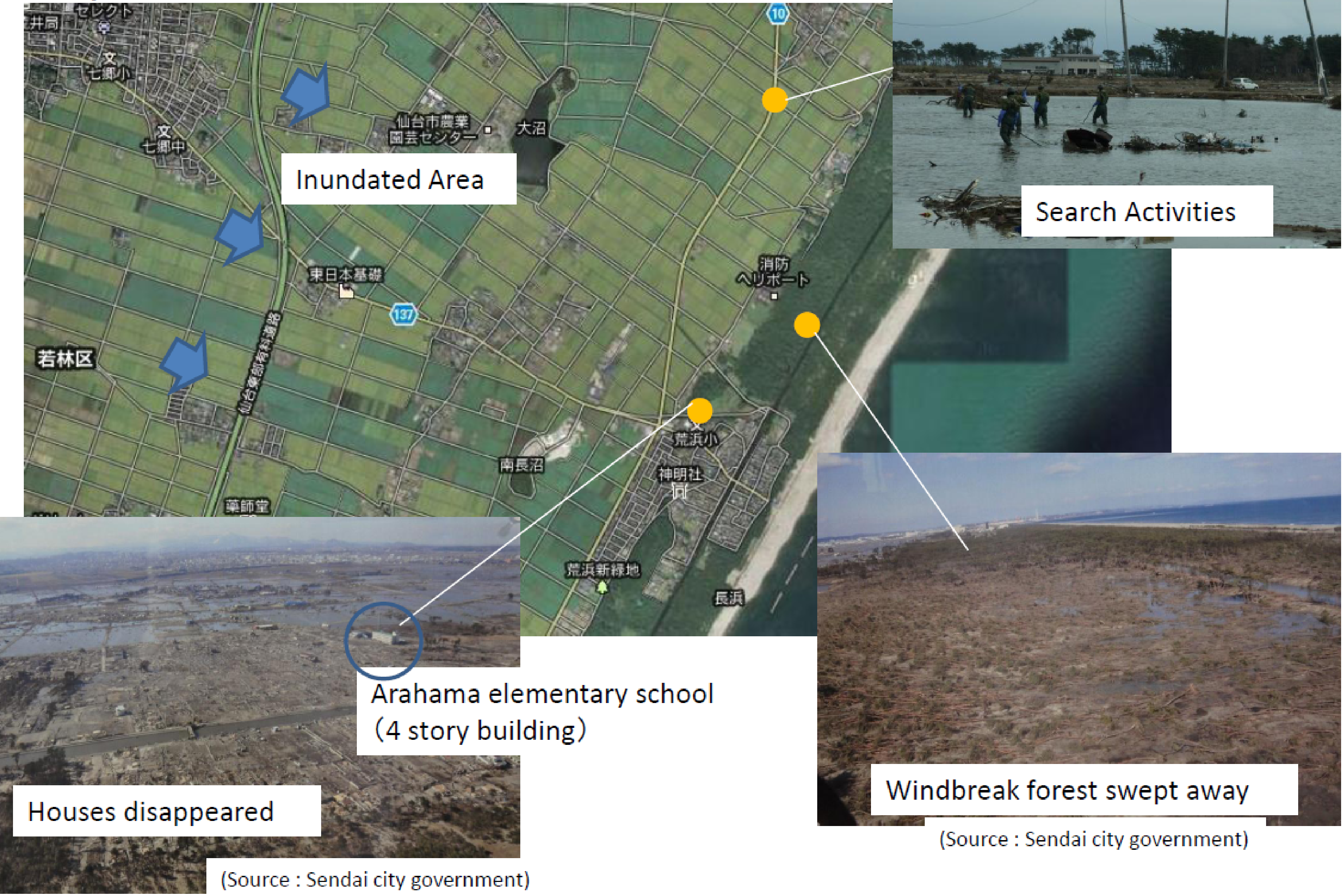


Cars and Trees swept away by tsunami



The foot of the column of Lawson signboard

Arahama, Wakabayashi-ward of Sendai City



Inundated Area

Search Activities

Arahama elementary school (4 story building)

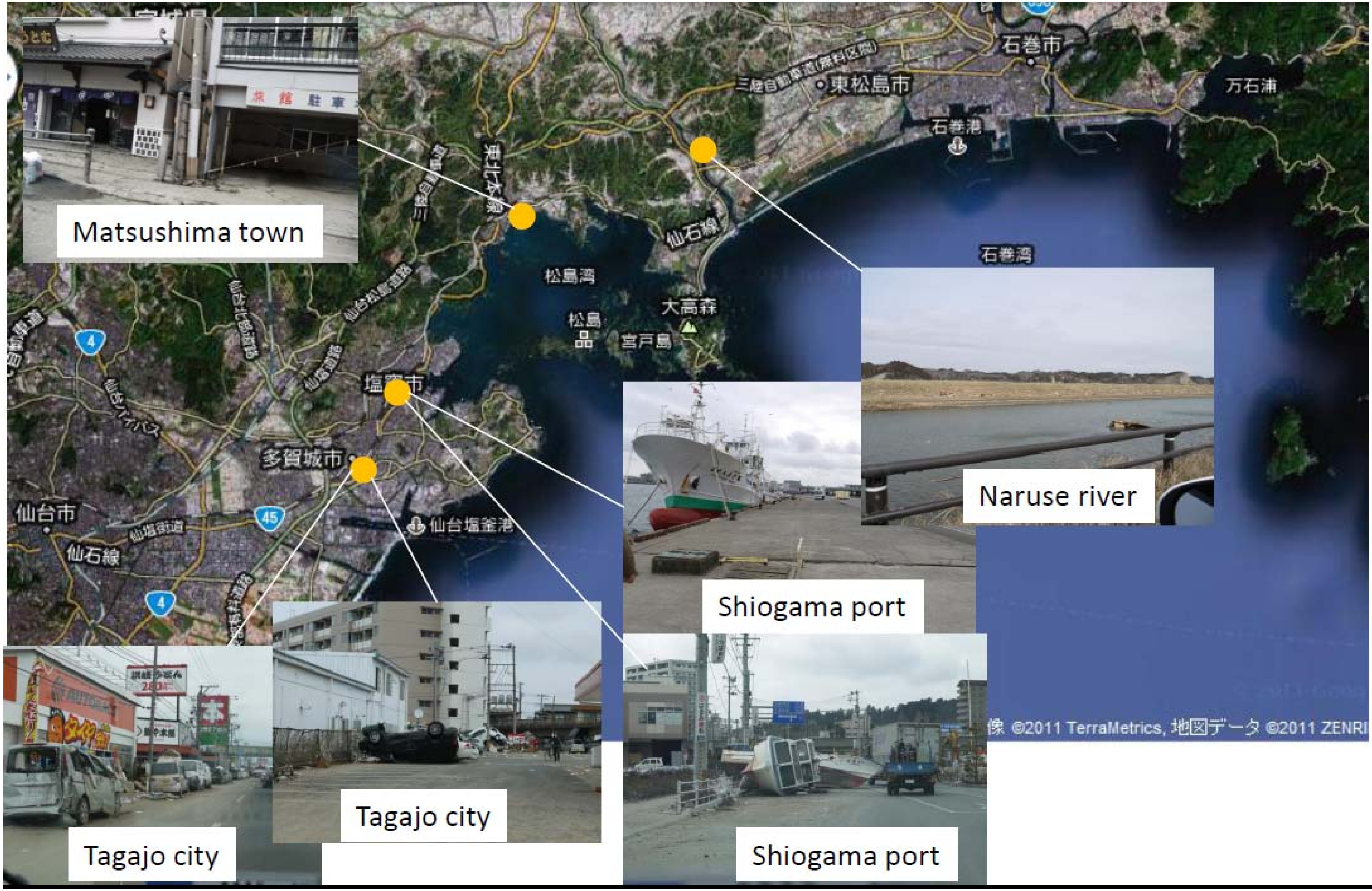
Houses disappeared

Windbreak forest swept away

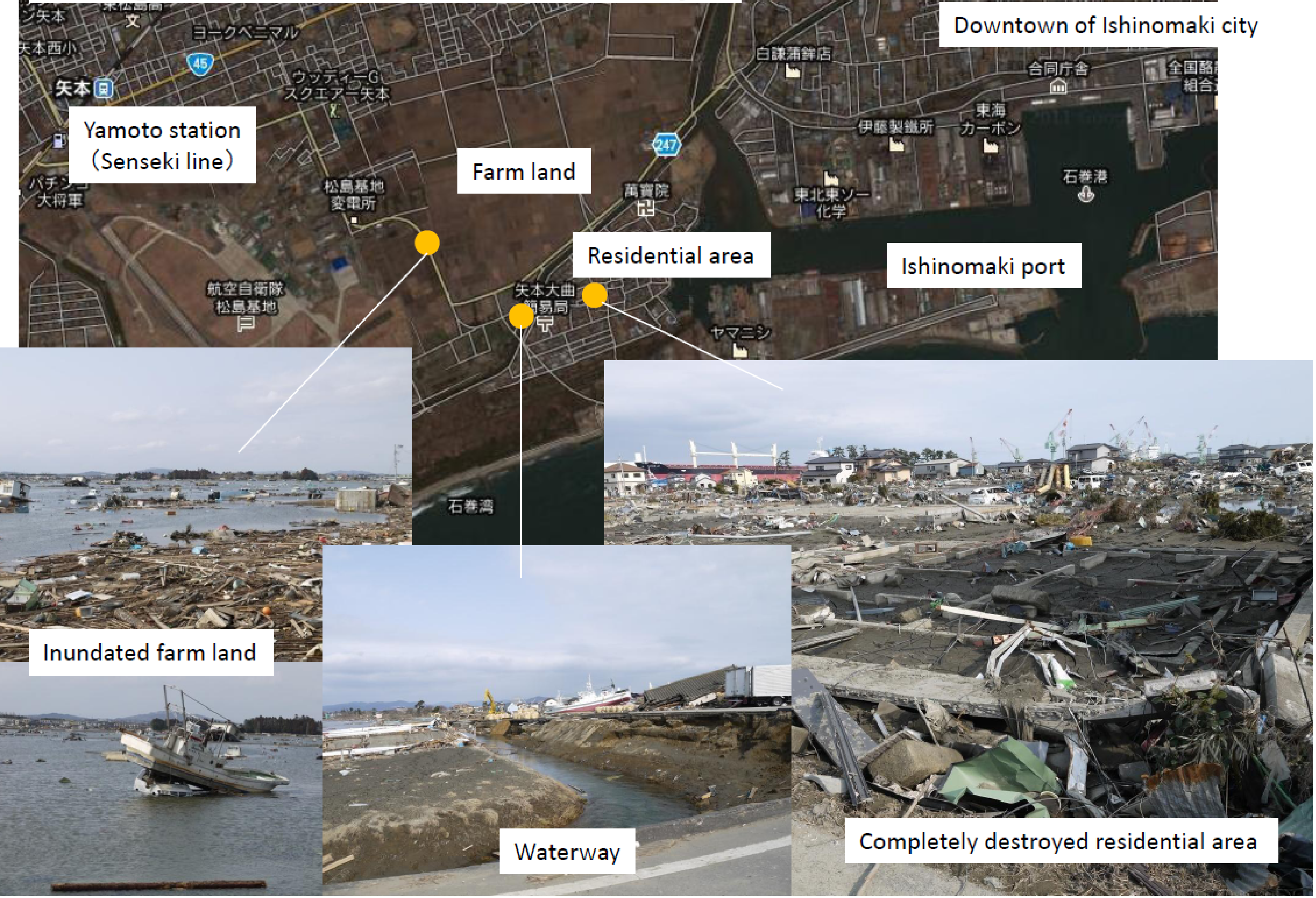
(Source : Sendai city government)

(Source : Sendai city government)

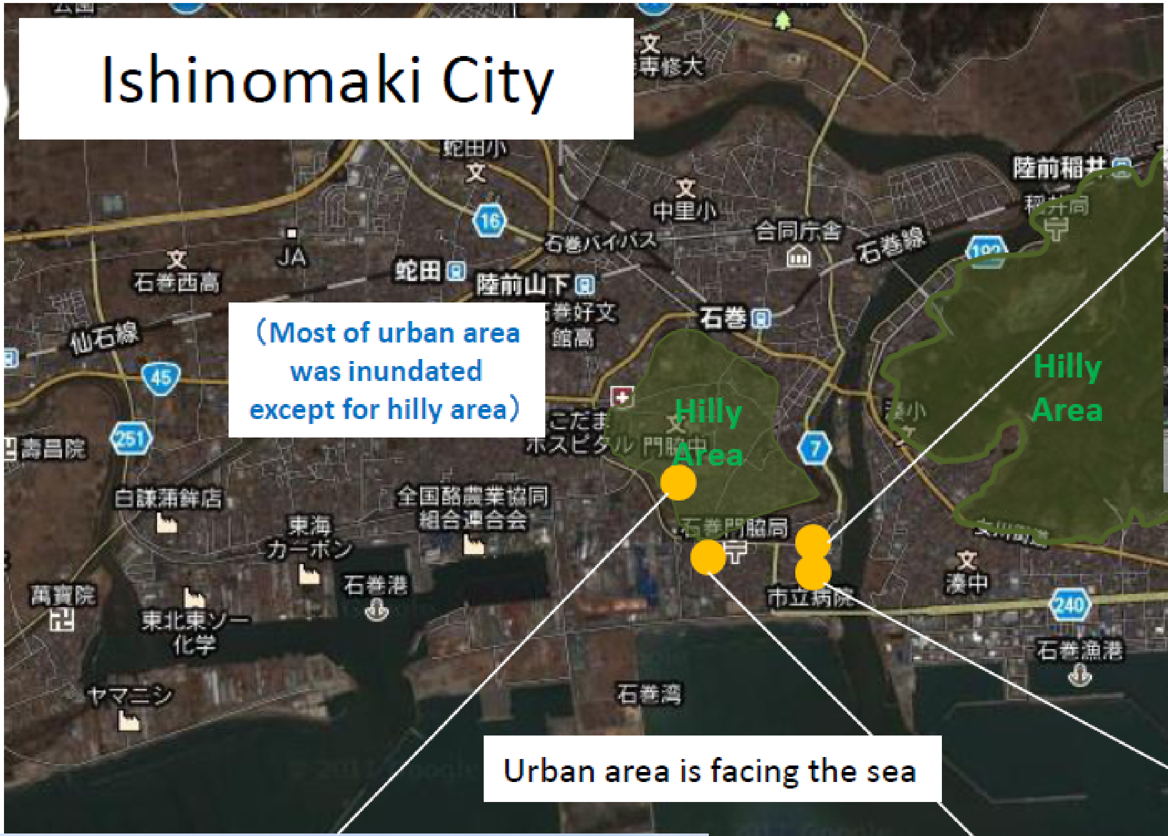
Area along Route 45　Tagajo City～Naruse River



Higashi-Matsusima City



Ishinomaki City



（Most of urban area was inundated except for hilly area）

Urban area is facing the sea

Factories destroyed by fire

Ishinomaki municipal hospital

Houses on a hill

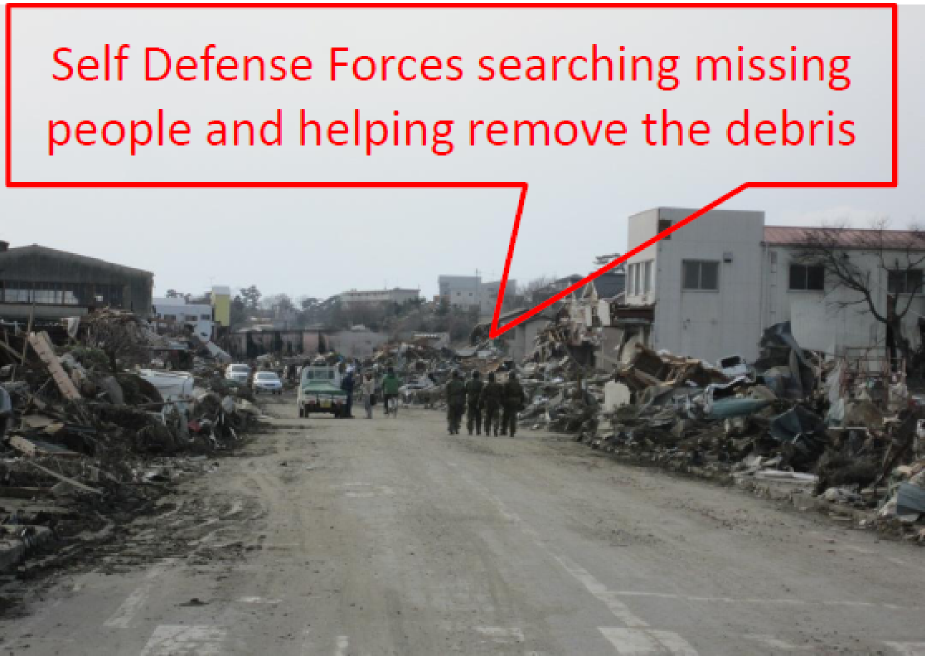
Houses destroyed by fire

Houses destroyed by tsunami

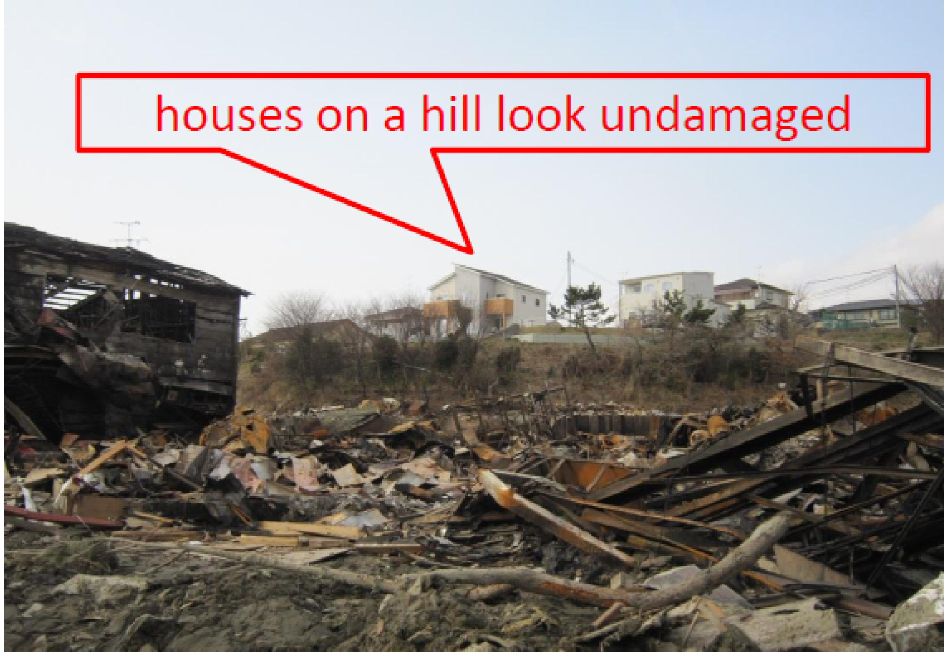
Ishinomaki City (22 March 2011)

Ishinomaki city is the second largest city in Miyagi Prefecture with population of around 160 thousand. Economically, it depends on fishing and marine product processing, shipbuilding and paper and pulp industries. 2,127 people have been confirmed died and 2,720 people missing (Miyagi Prefecture).

Kadowaki district (below), which was industrial areas close to the port with a river running just right beside, was washed away by tsunami and burnt down by subsequent spread fires. In clear contrast, houses standing on a hill looked undamaged from a distance.



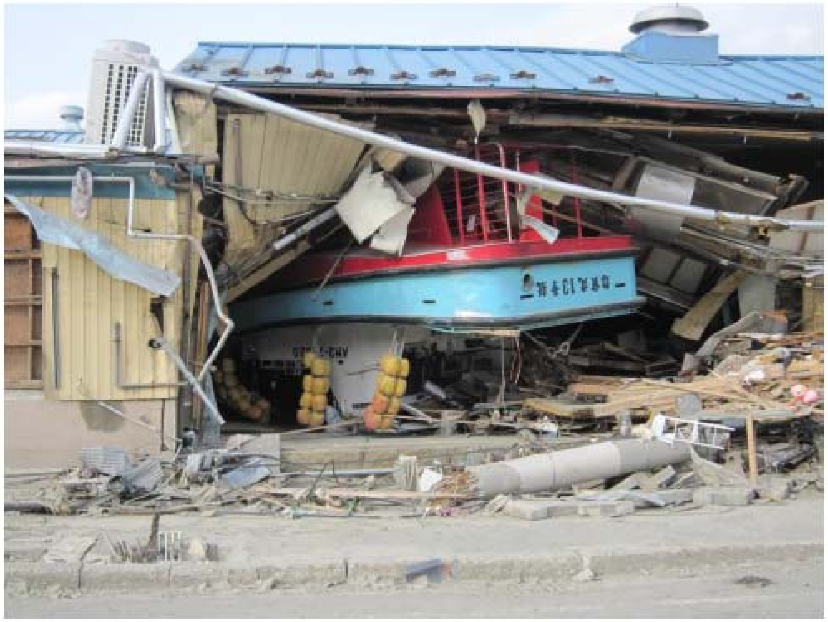
Self Defense Forces searching missing people and helping remove the debris

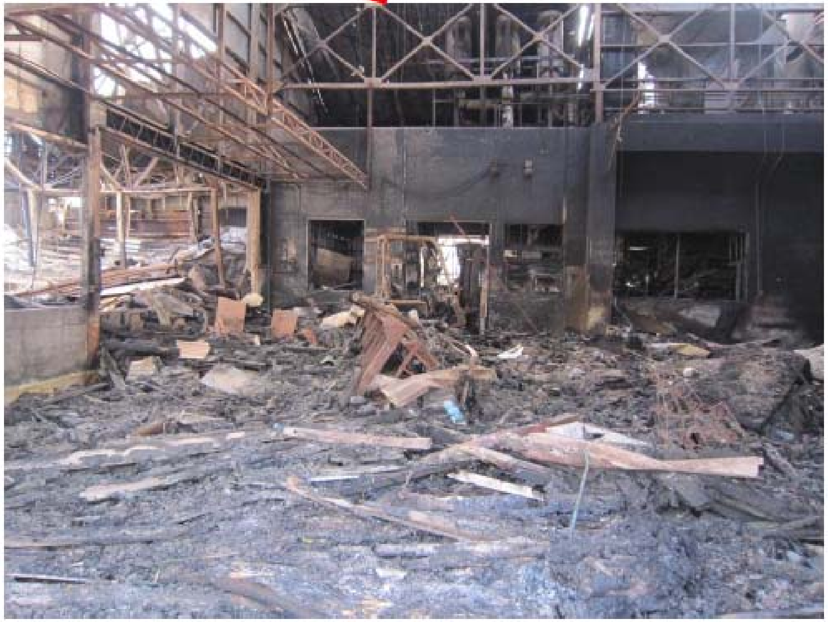


houses on a hill look undamaged

Ishinomaki city (22 March 2011)

Most of buildings in Kadowaki district collapsed. A close look at it reveals that they were not only collapsed by tsunami but also burned down by spread fires.

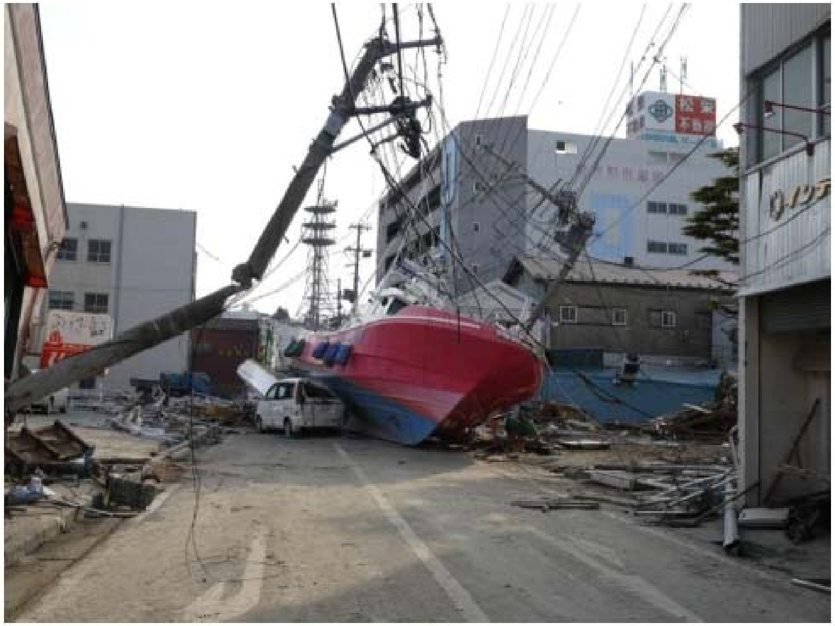


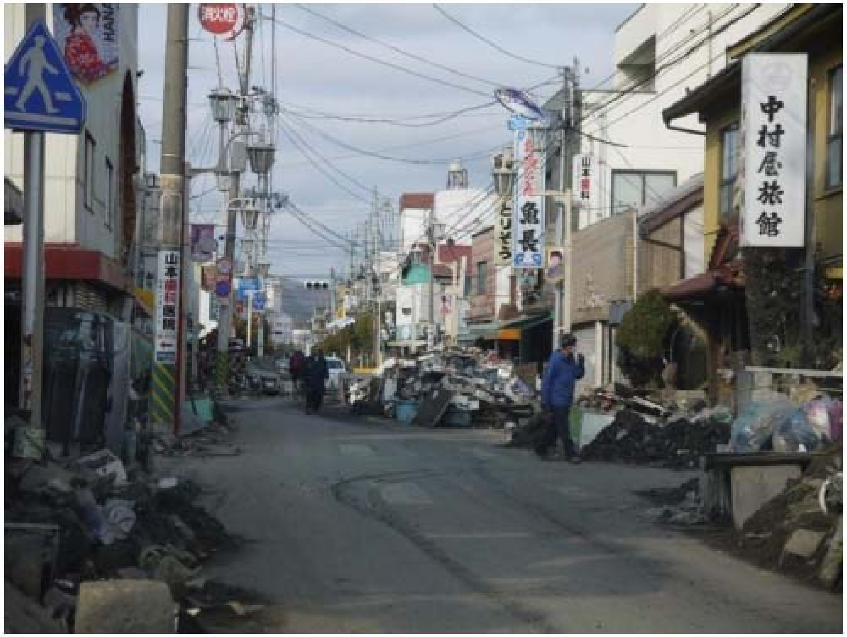


Inside warehouses and factories near the port

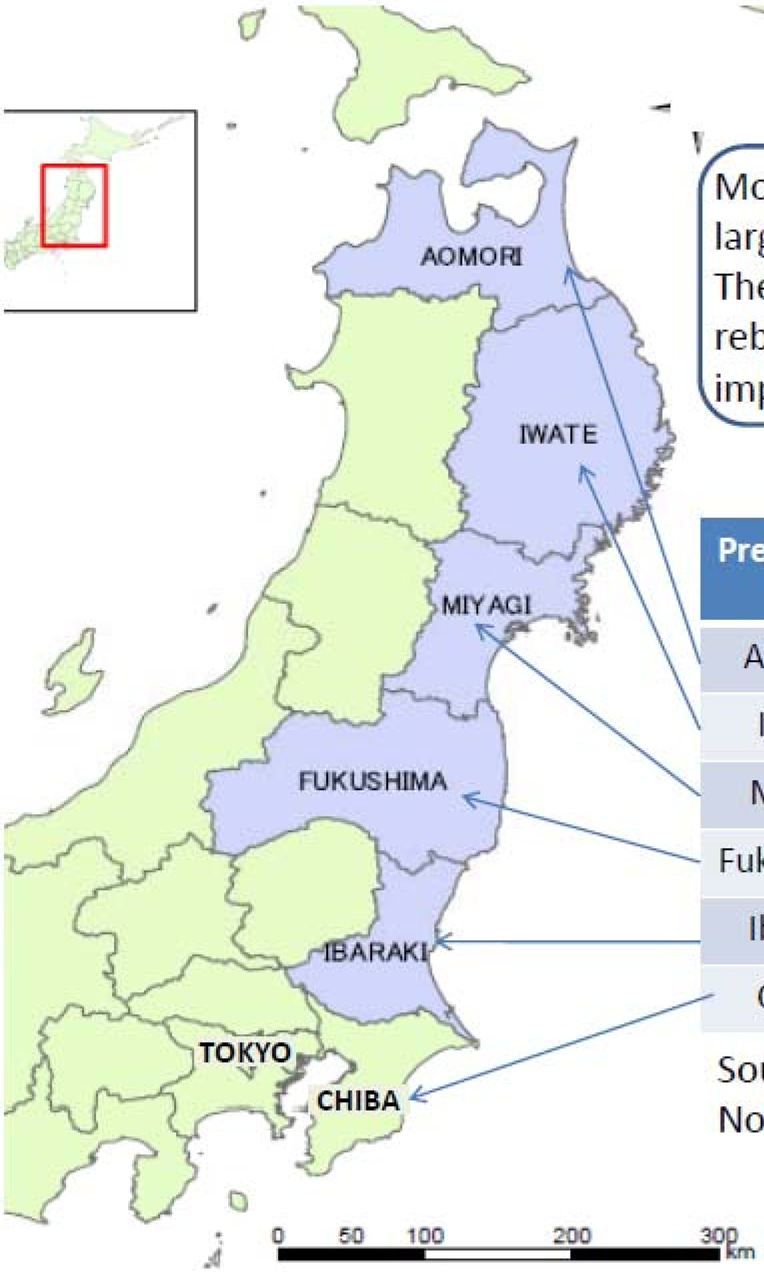
Ishinomaki city (22 March 2011)

The downtown areas of Ishinomaki city were inundated (1 to 3 meters) and many buildings (shops, restaurants, apartments) were heavily damaged. Ships, cars and debris were still scattered everywhere in downtown areas.





Damage to economic base



Most prefectures, severely hit by the tsunami, depend largely on agriculture and marine product industries. These key industries were badly damaged, and rebuilding these industrial bases is of supreme importance for local economy and job security.

Prefecture	Fishing boats	Fishing ports	Fields (10,000 m^2)
Aomori	546/6,990	17/92	79/19,680
Iwate	n.a/10,522	n.a./111	1,838/15,649
Miyagi	n.a./9.717	n.a./142	15,002/35,777
Fukushima	896/1,068	n.a./10	5,923/29,461
Ibaraki	249/1,215	15/24	531/21,679
Chiba	335/5,640	10/69	227/4,0826

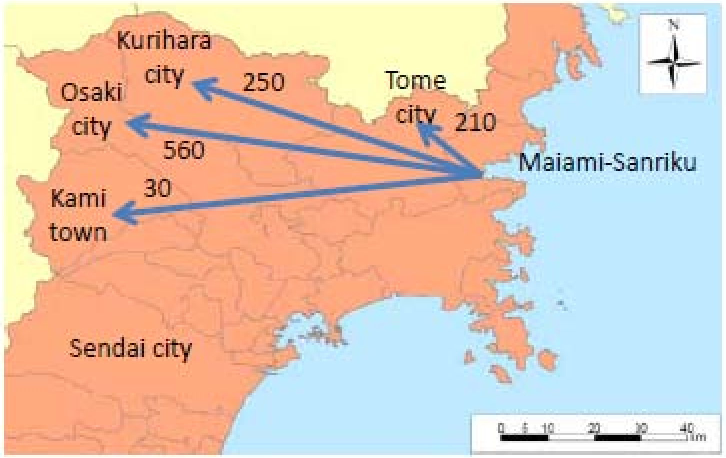
Source: Yomiuri Newspaper

Note: Estimate of damage/total
does not cover all disaster-affected prefectures.

Evacuation Center

More than 160 thousand displaced people are staying at evacuation centers such as community centers, schools, and sports stadiums (photo below left). This figure does not cover those who are staying at their homes, in cars, or elsewhere under harsh conditions. Since provision of temporary shelters will take many months and hygienic conditions at the evacuation centers continue to deteriorate, local authorities such as Minami-Sanriku town have started to temporarily relocate some evacuees to other places with better conditions such as hotels and public apartments in less disaster affected areas.

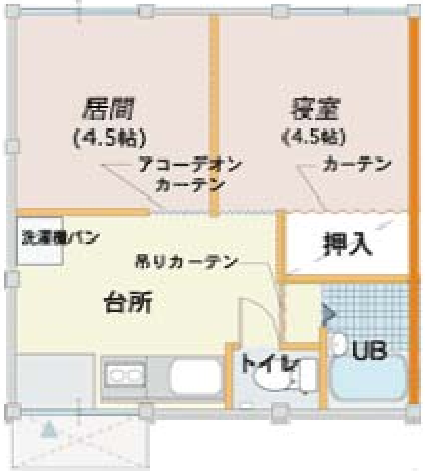
Evacuation center at Shizukawa primary school in Minami-Sanriku town



Source: based on NIKKEI Newspaper

Shelter

On March 14, MLIT requested the Japan Federation of Housing Organizations to construct 30,000 temporary housing units in two months. The construction started in Rikuzen-takata, Iwate Prefecture on March 19 followed by other cities and towns. As of April 5, about 4,216 temporary housing units were being constructed in 43 sites. Considering high demand, the prefectures have increased the number of required temporary housing units. In this regard, MLIT has requested housing companies to construct another 30,000 units in addition to the 30,000 units requested in March.



Typical design of temporary housing. Size is about 30 ㎡ comprising rooms, a kitchenette, a toilet, and a bath. Average cost for one unit is 2 million JPY. Usage is originally planned for two years, but may be extended for one more year.

Source: Yomiuri Online, Japan Prefabricated Construction Suppliers & Manufactures

Debris

The tsunami caused huge amount of debris from collapsed structures, washed away cars, boats, and other materials that have been scattered everywhere in tsunami-hit areas. Debris are still blocking the roads and streets. It has been reported that in Miyagi Prefecture alone, the estimated amount of debris is between 15 and 18 million tons - equivalent to 23 years of waste in usual situation. Moreover, there is a growing concern that debris might cause harmful effects to people's health and environment as the temperature starts rising and rainy season is coming in June.

Cleanup and disposal of debris is complicated because it has to consider many different things such as cars, boats, toxic waste, and items of personal value.

Ishinomaki city

Higashi-Matsushima city

Minami-Sanriku town

What worked and what did not work

Pacific Sea coast areas of Iwate Prefecture and the northern part of Miyagi Prefecture (Sanriku Coast) are known to be vulnerable tsunami as they had been devastated by recurrent tsunami caused by 1896 Meiji-Sanriku earthquake, 1933 Showa-Sanriku earthquake, and 1960 Chile earthquake.

Various measures, both structural and non-structural, had been taken in those areas to protect people and communities from tsunami . The most notable was the construction of 10m high and 2.5 km long dykes in Taro area of Miyako city, often called as “the Great Wall”, and the world biggest breakwater (8 meter high above sea which is 63 meter deep) in Kamaishi city. The structural measures must have reduced the impact of tsunami, but were found to be insufficient to protect people’s lives this time.

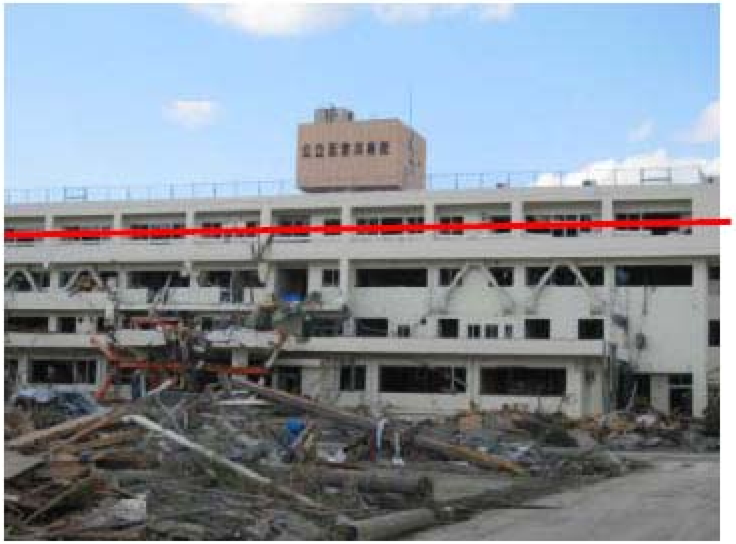
Major earthquake and tsunami that affected Sanriku Coast

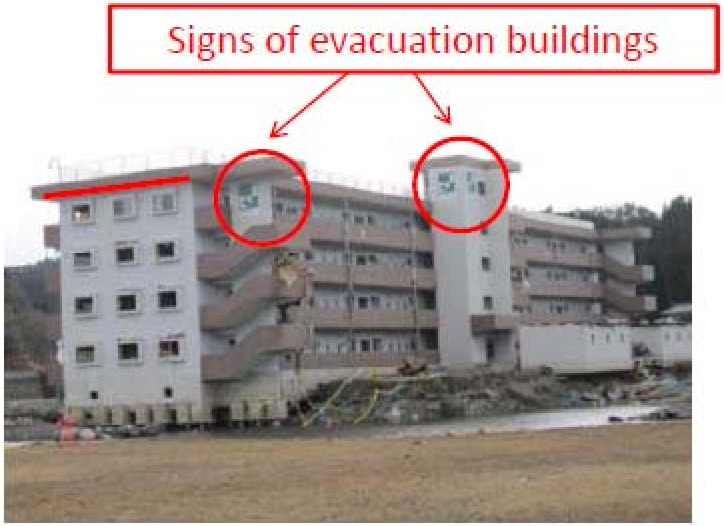
earthquake	date	Magnitude	epicenter	People died or missing	Maximum height of tsunami
Meiji-Sanriku	June 15 1896	M 8.2	Off Iwate	21,959 (Only people died)	38.2 (Ofunato city)
Showa-Sanriku	March 3 1933	M 8.1	Off Iwate	3,064	29.3 (Ofunato city)
Chile	May 22 1960	M 9.5	Off Chile in South America	142	5.6 (Miyako city)

Source: Yomiuri Newspaper

Implications to tsunami preparedness

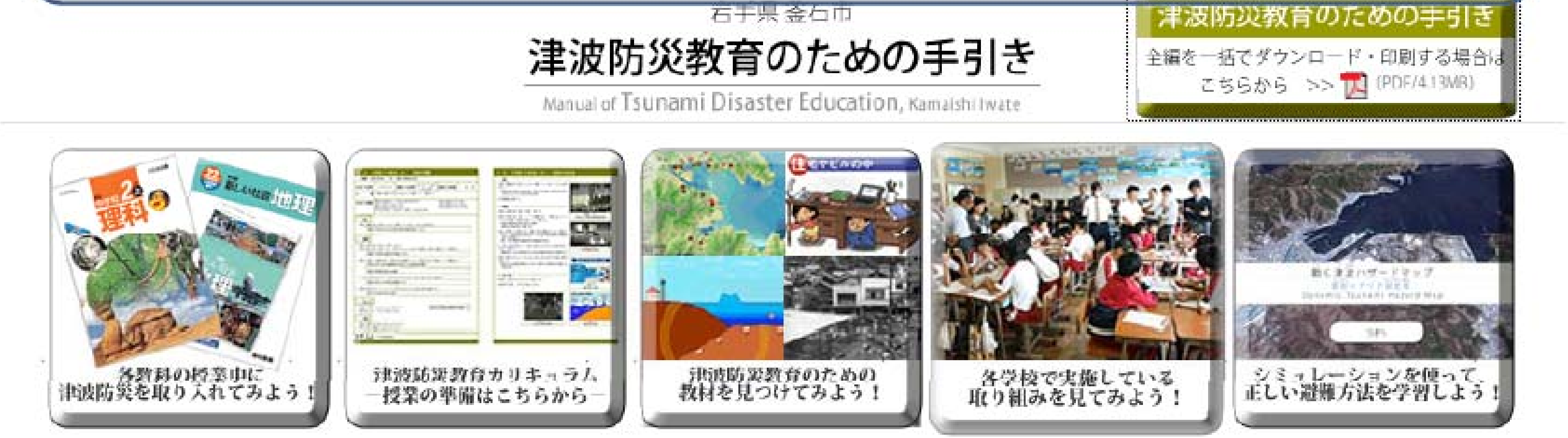
At Shizugawa hospital (left below) located near the coast (some 200 meters), there were traces indicating that tsunami had reached the 5th floor, and people at the rooftop deck managed to save their lives. This apartment building (right below), situated near the seashore, was designated as tsunami evacuation building and evacuation signs are indicated. In this apartment, there were traces that tsunami reached the 4th floor. It was generally believed that three-story RC buildings could be designated as evacuation buildings, but these have been found to be insufficient. Media (Yomiuri Newspaper) reported that tsunami waves reached almost one-tenth (123 out of 959) of the designated evacuation sites/centers in both Iwate and Miyagi Prefectures.





Implications to tsunami preparedness

Non-structural measures complement structural measures. Media has reported that measures such as the pre-disaster education and lessons learned from the past disasters helped people escape from tsunami as indicated in the following cases: The pre-disaster education, which had been conducted before the tsunami, guided the pupils at primary and junior high schools in Ishinomaki-city (one of the cities completely washed away) to successfully escape from tsunami. Mizuhama area in Ishinomaki city, total of 380 residents and about 130 households, was completely destructed by tsunami. However, only one person died and eight people reported missing. It has been revealed that people's awareness of what to do at the event of an earthquake and regular conduct of exercises/drills had helped them.



岩手県 釜石市
津波防災教育のための手引き
Manual of Tsunami Disaster Education, Kamaishi Iwate

津波防災教育のための手引き
全編を一括でダウンロード・印刷する場合は
こちらから >> (PDF/4.13MB)

Source: Kamaichi city

Other initiatives of government

✓The government is now preparing some bills, which propose various policy measures and necessary mechanism for full-fledged recovery and reconstruction, to be submitted to the Diet (Parliament). The proposal includes establishing new institutions to be responsible for recovery and reconstruction.

✓Likewise, the government is also preparing a supplementary budget proposal for deliberation to the Diet (Parliament), which is reported to be more than 3 trillion JPY.

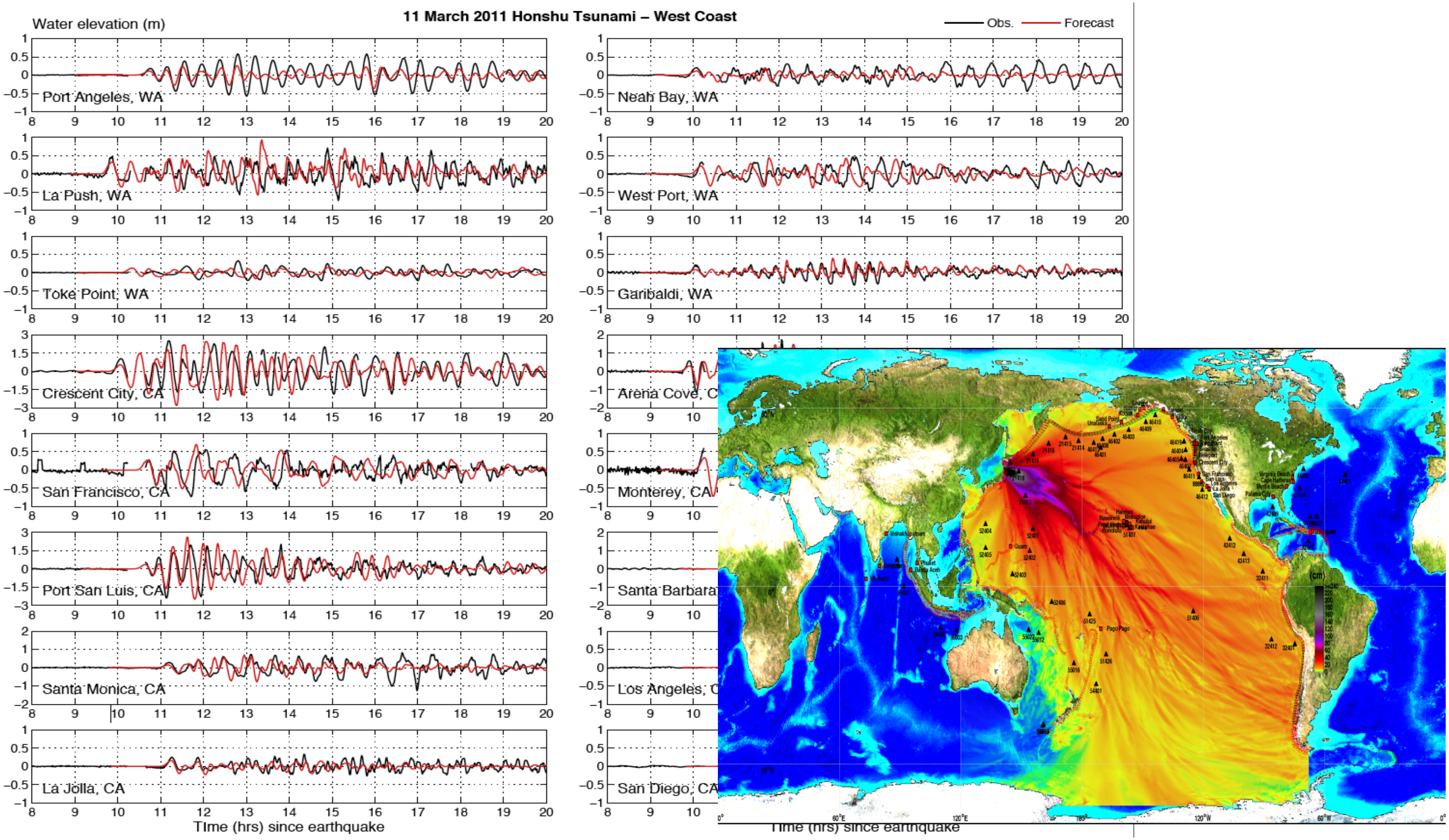
✓It is also reported that the government is examining a plan to relocate residents of tsunami-hit areas to higher ground and build new communities, and buying up areas totally devastated by tsunami - as these are not appropriate to rebuild communities.

✓To help local economy pickup, the government is considering a plan that gives preference to local businesses from disaster-hit areas in handing out restoration contracts in the first phase of government emergency employment assistance program, as this helps people affected by the March 11 earthquake and tsunami.

YES, it can & will happen here

	Tohoku EQ & Tsunami	**Cascadia Subduction Zone**
Magnitude of Events:	Magnitude 9.0	Est. Magnitude 9.0 (1700)
Peak Waves:	30’ wave heights	30’ wave heights (modeled)
Arrival Times:	~20 minutes	25-30 minutes (modeled)
Ground Subsidence:	3-feet	6-feet (projected)
Geologic Record of Events:	Yes	Yes

Washington State Tohoku Tsunami Response Timelines



Summary of Event

11:22 p.m.	March 10, 2011 – EMD SEOOs were following the Japanese earthquake sequence on the California Integrated Seismic Network when they received a notification from the West Coast and Alaska Tsunami Warning Center. The message was that Washington State would be placed under a Tsunami Watch, which indicates some action may be necessary, but data are still being processed.
11:30 p.m.	SEOOs relay info to EMD staff, coastal counties and tribes that West Coast Alaska Tsunami Warning Center has issued a Tsunami Watch for the Washington Coast and State Emergency Operations Center activates to Phase II level in order to support local jurisdictions, and tribes, and coordinate state agency resources to ensure life safety priorities giving as much time as possible for preparation and action.
12:47 p.m.	March 11 -, The West Coast and Alaska Tsunami Warning Center upgraded the Tsunami Watch to a **Tsunami Advisory**—the last stop in alert levels before an all-out Tsunami Warning. Already at Phase II, the State EOC ramped up immediately, effectively coordinating with and supporting local jurisdictions and tribes, as well as responding to media inquiries.

Summary of Event

PERIODIC	Providing the primary coordination between the Tsunami Warning Center and local jurisdictions, State EOC personnel conducted hourly conference calls with local emergency management offices to relay information and coordinate response decisions and actions, such as whether or not coastal sirens should be used (they were not). Local jurisdiction calls generally took place 10-15 minutes following a conference call between WCATWC, state warning points, and NWS Weather Forecast Offices. Updated Information obtained from regular conference calls between the West Coast and Alaska Tsunami Warning Center (WCATC) state warning points, and NWS Forecast Offices was disseminated to local jurisdictions. Subject matter experts from NOAA, NWS, and EMD were available on the call to provide guidance to local jurisdictions and address questions.
TBD	During the event, some areas of the coast in Grays Harbor County were projected to come close to meeting the criteria for a Tsunami Warning. However, with precise communication and coordination, the Tsunami Warning Center, State EOC and Grays Harbor County officials monitored the situation and used credible, authoritative data to determine that much of the coast did *not* have to be evacuated.
6:53 p.m.	SEOOs relay this 4:54 p.m. Bulletin from the West Coast BULLETIN (NUMBER 22) ALASKA TSUNAMI WARNING CENTER ...THE TSUNAMI ADVISORY HAS BEEN CANCELLED FOR BRITISH COLUMBIA, WASHINGTGON AND NORTHERN OREGON.

Washington EMD Mission:

Minimize the impact of emergencies and disasters on the people, property, environment, and economy of Washington State.

For the State Earthquake/Tsunami Program, that translates to:

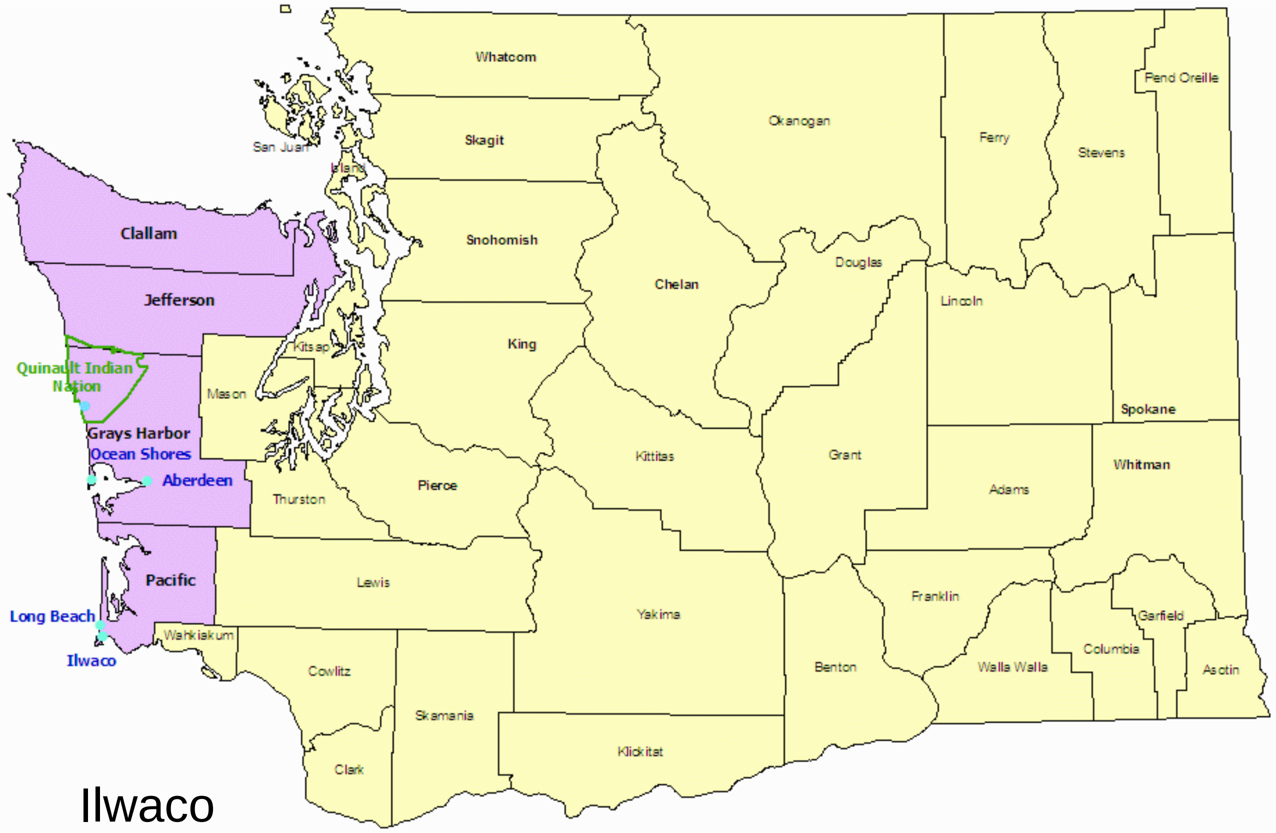
Preparedness – Public Education & Outreach, Exercises, Training

Mitigation – Planning, Policy Rec., Hazard & Risk Assessment

Response – HAZUS, Warnings Systems, etc.

Recovery – Improved Policies, Guidance for Land Use Planning

TsunamiReady™
NATIONAL WEATHER SERVICE



Washington

Aberdeen
Clallam County
Grays Harbor County
Jefferson County
Ocean Shores
Quinault Indian Nation
Shoalwater Bay Tribe
Ilwaco
Long Beach
Pacific County
Raymond
South Bend

Washington's Tsunami Risk

Three Sources:

- Distant

  (Alaska, Chile, Japan, etc.)
- Local

  (Cascadia, Seattle Fault,

  Tacoma Fault, SWIF)
- Landslides

House torn apart at Pacific Beach

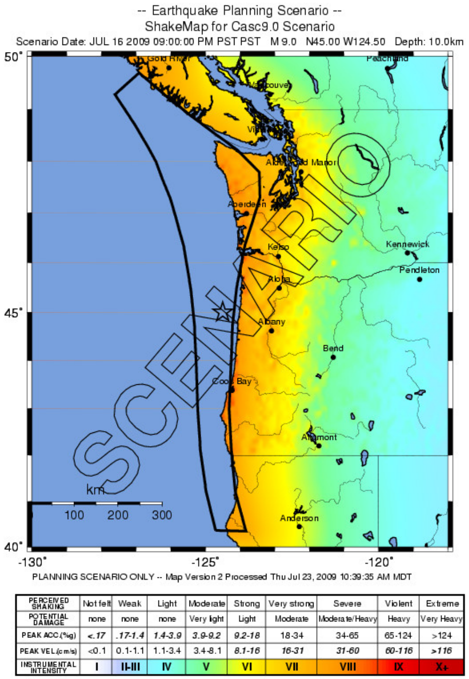
Highway 109 bridge over Copalis River

Tsunamis on average occur in the Pacific basin about six every 100 years

1964 Good Friday Tsunami on the Washington coast
– 9.2 Magnitude Alaskan Earthquake

Locally Generated Tsunami

- ❖ A locally generated tsunami is one that originates from a source that is close to the site of interest, and arrives within 30 minutes or less. The site of interest might also experience the effects of the triggering event.
- ❖ Key points:
  - ✓ Source is local
  - ✓ Ground shaking and sea level changes
  - ✓ Little to no warning
    - ➢ Ground shaking is your warning
  - ✓ Evacuation starts with natural warning

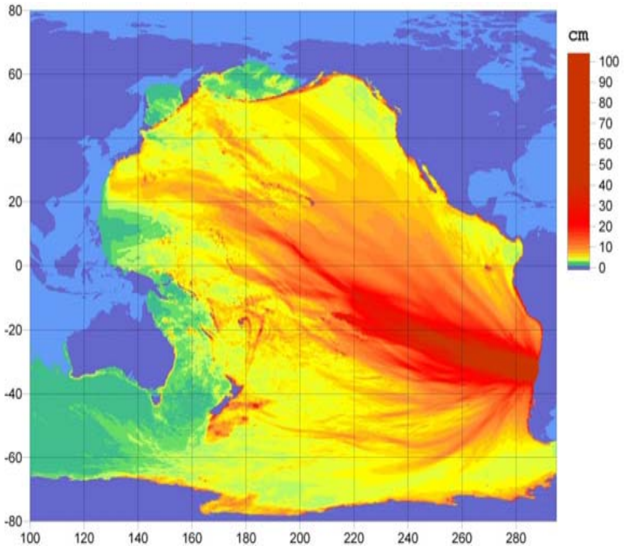

-- Earthquake Planning Scenario --
ShakeMap for Casc9.0 Scenario
Scenario Date: JUL 16 2009 09:00:00 PM PST PST M 9.0 N45.00 W124.50 Depth: 10.0km

PLANNING SCENARIO ONLY -- Map Version 2 Processed Thu Jul 23, 2009 10:39:35 AM MDT

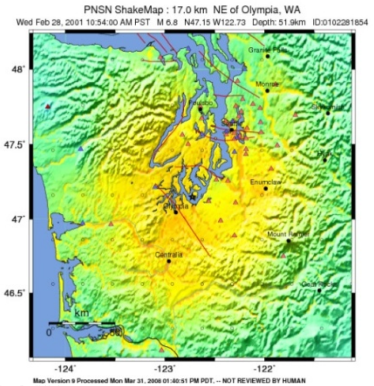
PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+

Distant Source Generated Tsunami

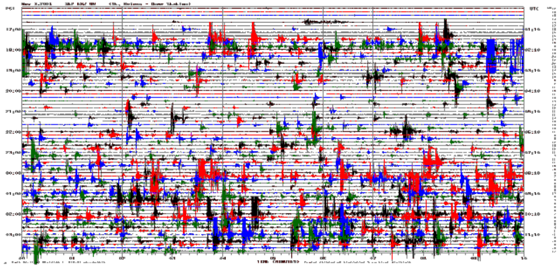
- ❖ A distant source generated tsunami is one that originates from a source that is far away from the site of interest, and takes 2 hours or longer after the triggering event to arrive.
- ❖ Key points:
  - ✓ Source is distant – example: Alaska, Chile, Kuril Islands
  - ✓ Official and unofficial information
  - ✓ Official evacuation



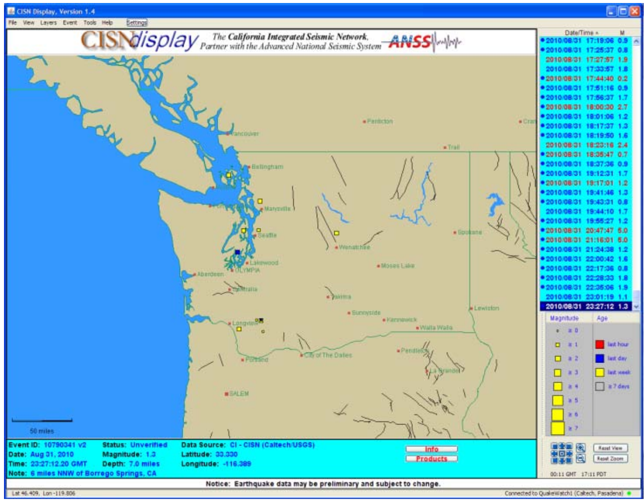
Real-time Earthquake Detection & Notification


PNSN ShakeMap : 17.0 km NE of Olympia, WA
Wed Feb 28, 2001 10:54:00 AM PST M 6.8 N47.15 W122.73 Depth: 51.9km ID:0102281854
48°
47.5°
47°
46.5°
-124°
-123°
-122°
Granite Falls
Monroe
Enumclaw
Centralia
km
Map Version 9 Processed Mon Mar 31, 2008 01:40:51 PM PDT -- NOT REVIEWED BY HUMAN

- Monitoring provided by United States Geological Survey (USGS) – Pacific Northwest Seismic Network (PNSN)



- Notification by PNSN of Depth, Location, Magnitude of earthquakes sent to EMD Duty Officers and shown on California Integrated Seismic Network (CISN) display.


CISN Display, Version 1.4
File View Layers Event Tools Help Settings
CISNdisplay The California Integrated Seismic Network Partner with the Advanced National Seismic System ANSS
Date/Time
M
Magnitude
Age
last hour
last day
last week
≥ 7 days
50 miles
SALEM
Info
Products
Reset View
Reset Zoom
00:11 GMT 17:11 PDT

Event ID: 10790341 v2
Date: Aug 31, 2010
Time: 23:27:12.20 GMT
Note: 6 miles NNW of Borrego Springs, CA
Status: Unverified
Magnitude: 1.3
Depth: 7.0 miles
Data Source: CI - CISN (Caltech/USGS)
Latitude: 33.330
Longitude: -116.389

Notice: Earthquake data may be preliminary and subject to change.

Lat 46.409, Lon -119.806
Connected to QuakeWatch1 (Caltech, Pasadena)

- Use of USGS Products for response such as CISN, ShakeMap, PAGER, Did you Feel It? for situational awareness, response, and recovery

- Preliminary discussions about how to integrating real-time GPS monitoring through PANGA into existing processes.

EMD Earthquake Program Overview

- Emphasis on Public Education and Awareness
- Conduct specialized training for first responders and community leaders
- Develop & support local, state, federal, and private industry exercises
- Support statewide drop, cover, and hold drills for schools, businesses, etc.
- Conduct special projects:
  - Earthquake Scenario Catalog
  - The Resilient Washington State Initiative
  - School Seismic Needs Assessment
  - Tsunami Safe Haven Project

- Support Washington State's Seismic Safety Committee

The Big Picture: Where do the State and Local Tsunami Programs Fit In?

- **NOAA**

National Weather Service

- **National Tsunami Hazard Mitigation Program**

WA EMD & Dept. of Natural Resources

- **Washington State**

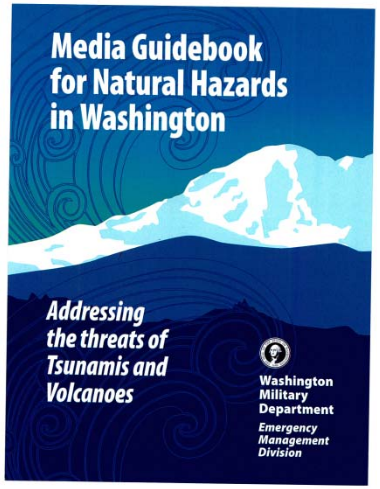
State\Local Tsunami Workgroup

- **Local Jurisdictions\Tribes**

Earthquake Program Products & Services

- Partner with science agencies (USGS at the University of Washington and State Geological Survey) on workshops/ training/exercise support
- Support the EMD Public Education Program on Outreach Programs (i.e. *Map Your Neighborhood and Drop, Cover, and Hold Drills*) and Preparedness Products (*All Hazards Guide, School Curriculum, etc.*)
- All-Hazards Disaster Preparedness and Response Program for the Hospitality Industry (Emphasis on Earthquakes and Tsunamis)
- Natural Hazards Media Guidebook – Helps engage media outlets directly and provide tools that ensure they deliver the right messages to the public during emergencies

The Adventures of
Terry the Turtle and
Gracie the Wonder Dog
Grades 3 – 6
FEMA 531 / August 2005
FEMA
nehrp



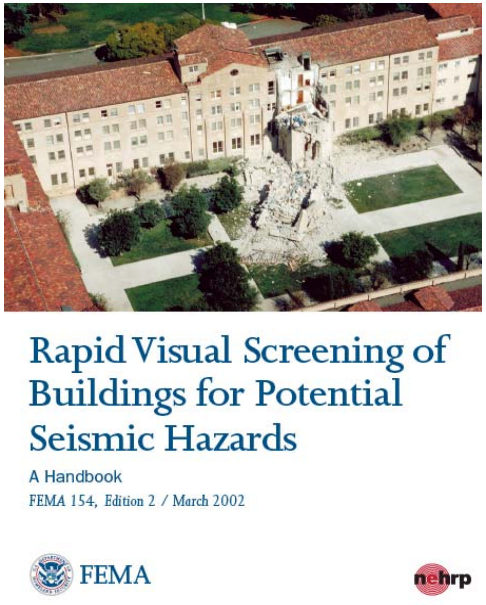
Media Guidebook
for Natural Hazards
in Washington

Addressing
the threats of
Tsunamis and
Volcanoes

Washington
Military
Department
Emergency
Management
Division

Earthquake Program Products & Services

- Coordinate with EMD Training Program for earthquake specific training courses:
  - Rapid Visual Screening of Buildings for Potential Seismic Hazards
  - Post Earthquake Screening of Buildings
    - 250+ people trained per year throughout the State.



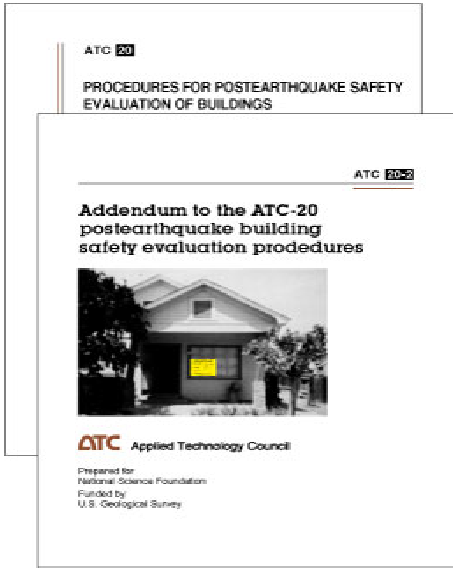
Rapid Visual Screening of Buildings for Potential Seismic Hazards

A Handbook

FEMA 154, Edition 2 / March 2002

FEMA

nehrp



ATC 20

PROCEDURES FOR POSTEARTHQUAKE SAFETY EVALUATION OF BUILDINGS

ATC 20-2

Addendum to the ATC-20 postearthquake building safety evaluation prodedures

ATC Applied Technology Council

Prepared for
National Science Foundation
Funded by
U.S. Geological Survey

Public Education and Outreach

Public education is the cornerstone to success

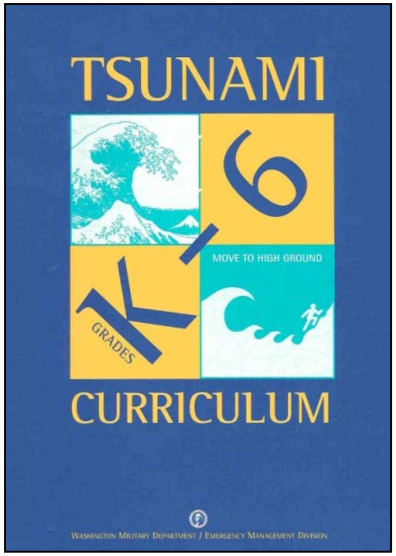
- Social science is part of the process!
  - 2010 E. Washington EQ Hazard Perception Baseline Survey
  - 2008-2010 Coastal Tsunami Awareness
  - 2007-2009 Lahar Drill Evaluations
- Risk communications -- key to how people will respond
- Exercise and drill response plans
- Train citizens and responders on the use of tools

Education Program Focus:

- Residents
- School Aged Children
- Tourists
- Business Community
- Media

Public Education and Outreach

- **Earthquake Program, in partnership with EMD Public Education Program, DNR- Geology Division, Local Emergency Managers, etc. conduct:**
  - Workshops
  - Forums
  - Town Hall Meetings
  - Exercises
  - Evacuation Drills
  - Preparedness Campaigns



TSUNAMI

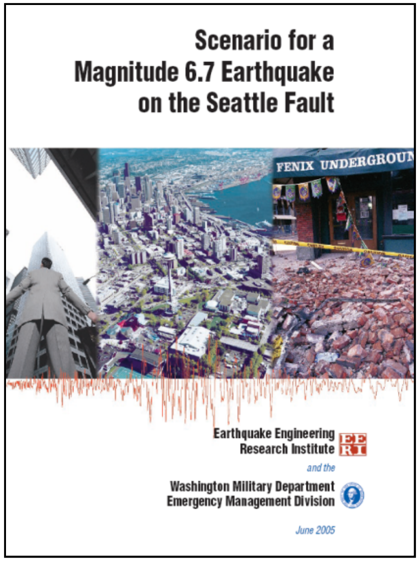
K-6

GRADES

MOVE TO HIGH GROUND

CURRICULUM

WASHINGTON MILITARY DEPARTMENT / EMERGENCY MANAGEMENT DIVISION



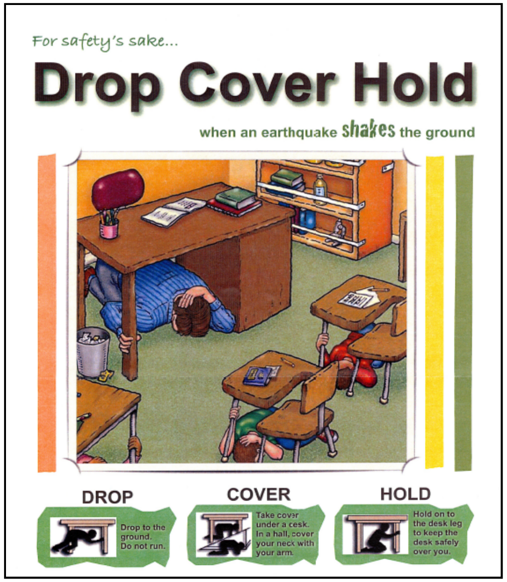
Scenario for a Magnitude 6.7 Earthquake on the Seattle Fault

Earthquake Engineering Research Institute

and the

Washington Military Department Emergency Management Division

June 2005



For safety's sake...

Drop Cover Hold

when an earthquake shakes the ground

DROP

Drop to the ground. Do not run.

COVER

Take cover under a desk. In a hall, cover your neck with your arm.

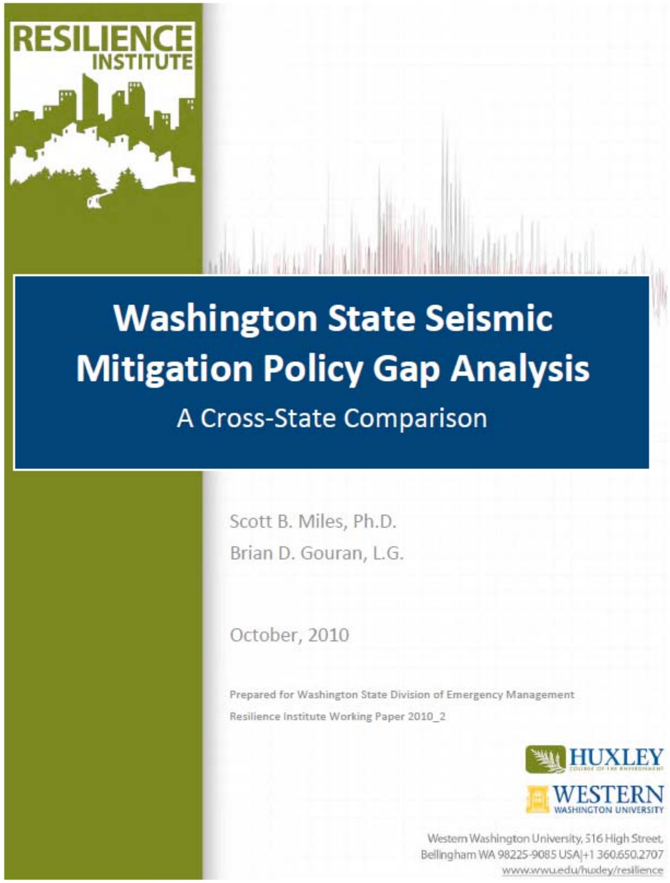
HOLD

Hold on to the desk leg to keep the desk safely over you.

Special Projects

Use Innovative Solutions!

- EQ Scenario Catalog
- Examining Business Occupancy Resumption Program (BORP)
- The Resilient Washington State Initiative
- Comparative Analysis of Seismic Risk Reduction Legislation
- School Seismic Safety Assessments
- Online Tsunami Evacuation Maps
- All Hazards Guide Template
- Tsunami Warning Communications Test
- Project Safe Haven



RESILIENCE INSTITUTE

Washington State Seismic Mitigation Policy Gap Analysis

A Cross-State Comparison

Scott B. Miles, Ph.D.
Brian D. Gouran, L.G.

October, 2010

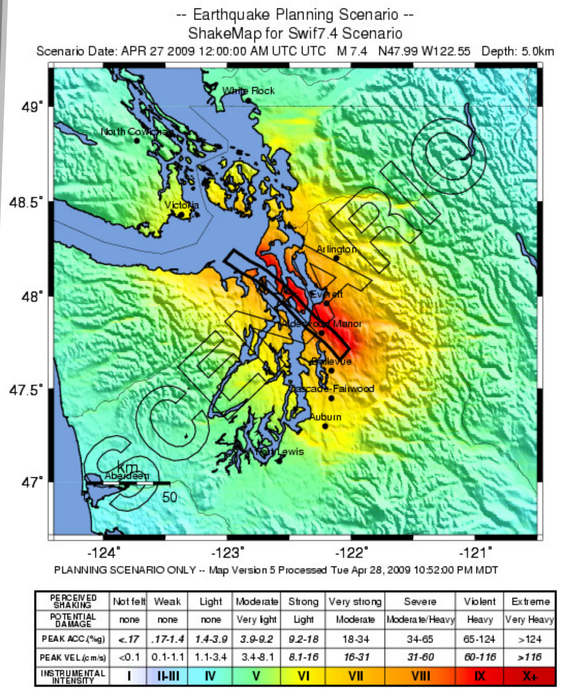
Prepared for Washington State Division of Emergency Management
Resilience Institute Working Paper 2010_2

HUXLEY
COLLEGE OF THE ENVIRONMENT

WESTERN
WASHINGTON UNIVERSITY

Western Washington University, 516 High Street,
Bellingham WA 98225-9085 USA|+1 360.650.2707
www.wwu.edu/huxley/resilience

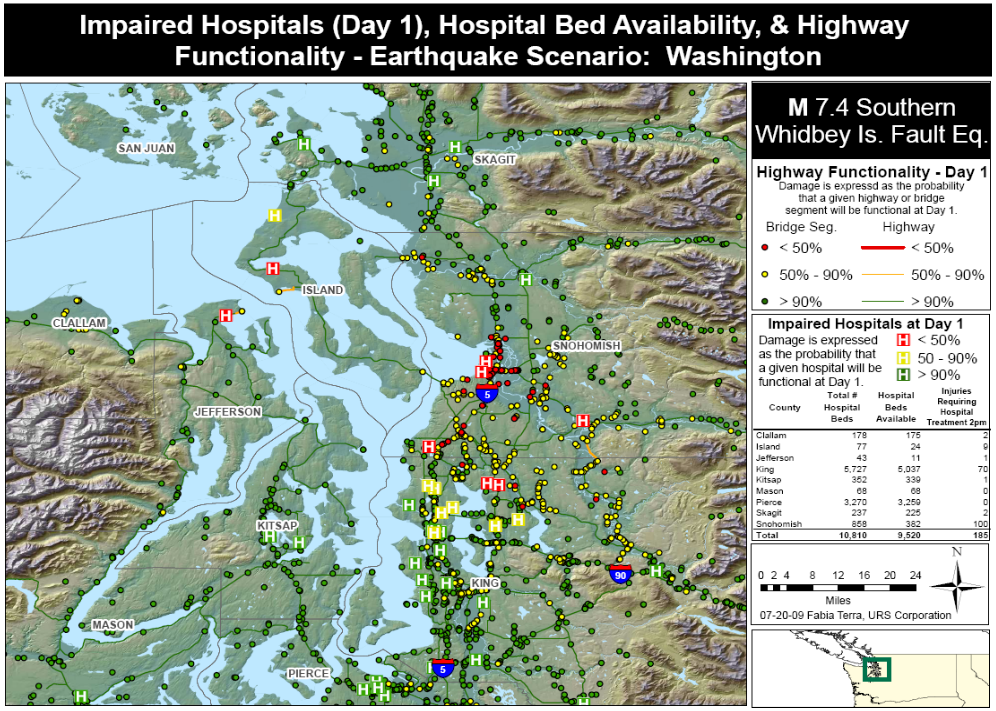
Earthquake Scenario Catalog



-- Earthquake Planning Scenario --
ShakeMap for Swif7.4 Scenario
Scenario Date: APR 27 2009 12:00:00 AM UTC UTC M 7.4 N47.99 W122.55 Depth: 5.0km

PLANNING SCENARIO ONLY -- Map Version 5 Processed Tue Apr 28, 2009 10:52:00 PM MDT

PERCEIVED SHAKING	Not felt	Weak	Light	Moderate	Strong	Very strong	Severe	Violent	Extreme
POTENTIAL DAMAGE	none	none	none	Very light	Light	Moderate	Moderate/Heavy	Heavy	Very Heavy
PEAK ACC.(%g)	<.17	.17-1.4	1.4-3.9	3.9-9.2	9.2-18	18-34	34-65	65-124	>124
PEAK VEL.(cm/s)	<0.1	0.1-1.1	1.1-3.4	3.4-8.1	8.1-16	16-31	31-60	60-116	>116
INSTRUMENTAL INTENSITY	I	II-III	IV	V	VI	VII	VIII	IX	X+



Impaired Hospitals (Day 1), Hospital Bed Availability, & Highway Functionality - Earthquake Scenario: Washington

M 7.4 Southern Whidbey Is. Fault Eq.

Highway Functionality - Day 1
Damage is expressd as the probability that a given highway or bridge segment will be functional at Day 1.

Bridge Seg.	Highway
● < 50%	< 50%
● 50% - 90%	50% - 90%
● > 90%	> 90%

Impaired Hospitals at Day 1
Damage is expressed as the probability that a given hospital will be functional at Day 1.
H < 50%
H 50 - 90%
H > 90%

County	Total # Hospital Beds	Hospital Beds Available	Injuries Requiring Hospital Treatment 2pm
Clallam	178	175	2
Island	77	24	9
Jefferson	43	11	1
King	5,727	5,037	70
Kitsap	352	339	1
Mason	68	68	0
Pierce	3,270	3,259	0
Skagit	237	225	2
Snohomish	858	382	100
Total	10,810	9,520	185

07-20-09 Fabia Terra, URS Corporation

Projected Uses:

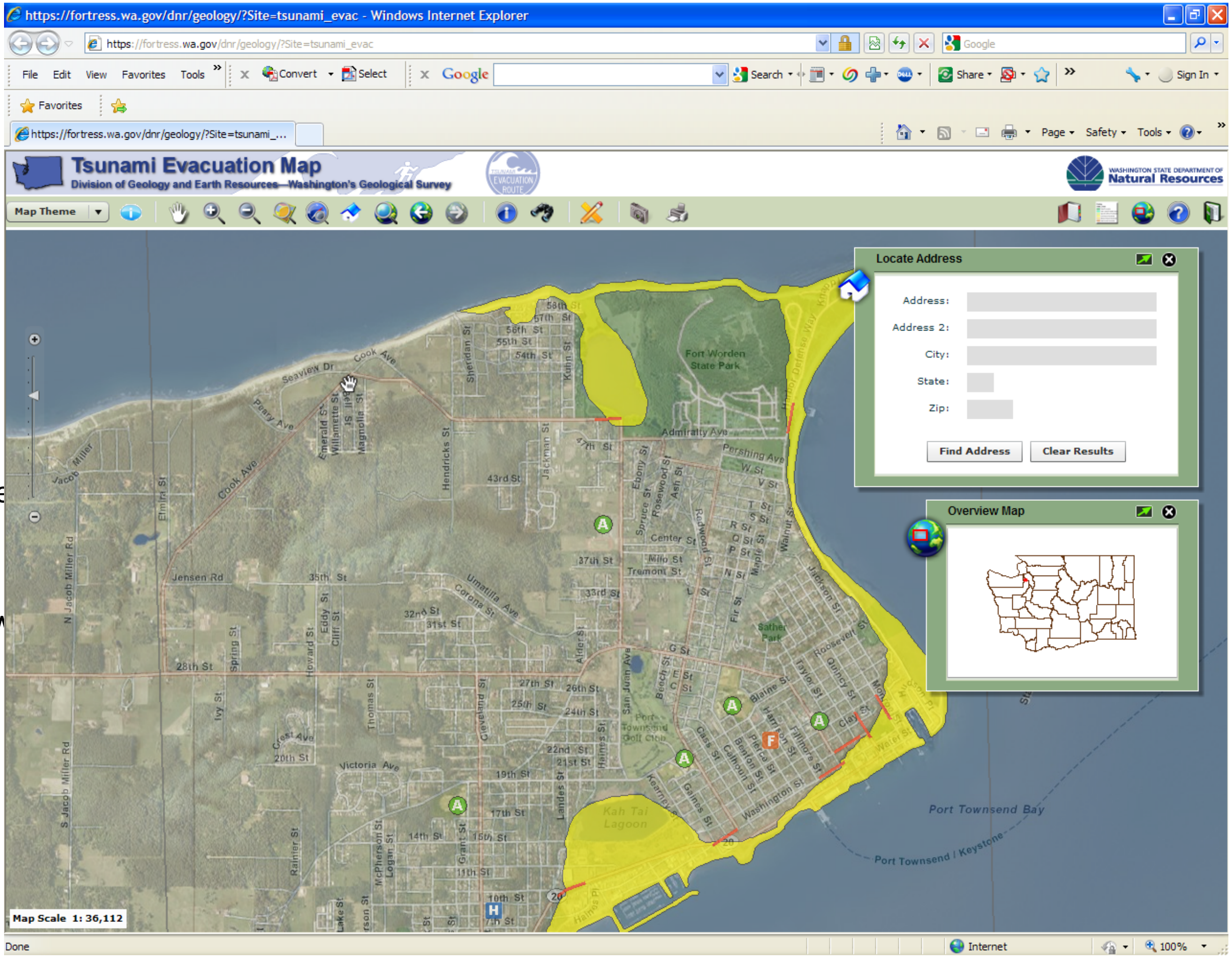
- Mitigation Planning
- Response Planning
- Exercises & Training
- Earthquake Response

Suite of Materials Including:

- USGS ShakeMap
- HAZUS (Loss Estimation) Report
  - Statewide & 7 most impacted counties
- Community Vulnerability Report
- Variety of Quick Reference Maps

NEW Online Tsunami Evacuation Mapping Tool

- Created by WA DNR to replace outdated ArcIMS server product.
- MUCH more user friendly and easy to navigate!!!
- Includes address locator, assembly areas, and inundation zones.
  - Next phase may include pictures of assembly areas
  - Trying to figure out how to turn into a smartphone app.
- Uses ESRI base maps, to eliminate ongoing cost to update imagery, roads, etc.



Project Safe Haven:

Tsunami Vertical Evacuation

Long Beach Peninsula/Pacific County

SHOALWATER BAY TRIBE
NAHPS CHAAHTS

NATIONAL WEATHER SERVICE

National Tsunami Hazard Mitigation Program

USGS
science for a changing world

WASHINGTON STATE DEPARTMENT OF
Natural Resources

UNIVERSITY of WASHINGTON

PACIFIC COUNTY WASHINGTON

NOAA

Washington Military Department
Emergency Management Division

ARCH | CM | LA | UDP

TSUNAMI EVACUATION ROUTE

Safe Haven Planning Process

Kick off Meeting with Local Emergency Manager

Community World Café Meeting

(Gather initial community input)

Alternatives Analysis

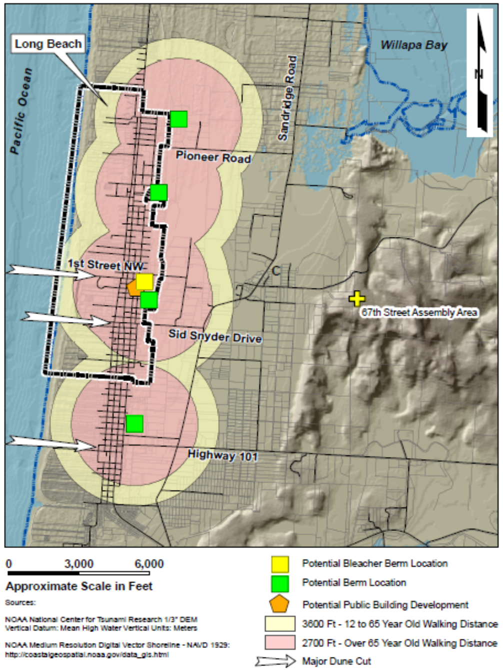
(SWOT)

Development of Preferred Alternative

Urban Design Charrette

Community Ranking of Locations & Final Plan Development

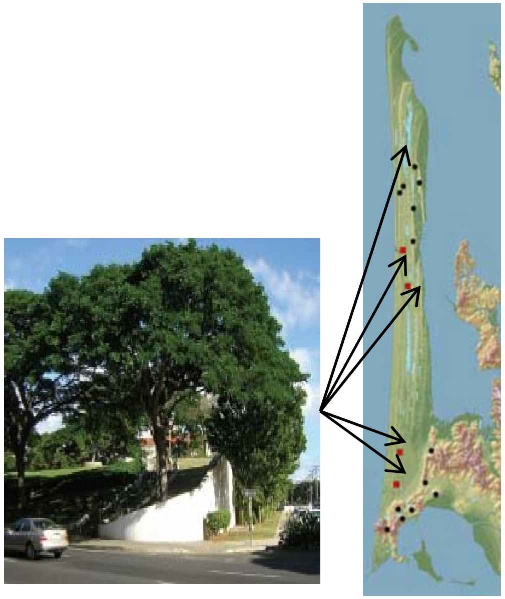
Figure 2 - Preferred Strategy


Long Beach
Pacific Ocean
Willapa Bay
Sandridge Road
Pioneer Road
1st Street NW
Sid Snyder Drive
67th Street Assembly Area
Highway 101
C
N
0
3,000
6,000
Approximate Scale in Feet
🟨 Potential Bleacher Berm Location
🟩 Potential Berm Location
⬟ Potential Public Building Development
▭ 3600 Ft - 12 to 65 Year Old Walking Distance
▭ 2700 Ft - Over 65 Year Old Walking Distance
⇨ Major Dune Cut

Sources:

NOAA National Center for Tsunami Research 1/3" DEM
Vertical Datum: Mean High Water Vertical Units: Meters

NOAA Medium Resolution Digital Vector Shoreline - NAVD 1929:
http://coastalgeospatial.noaa.gov/data_gis.html



Safe Haven Options (from FEMA 646):

Towers –
- Limited Space
- Blocks Views
- Few Options for Shelter

Buildings –
- Expensive
  - Better get it right the first time!
- Very Large, Likely to Block Views
- May require Private Development
  - Incentives for Height?

Berms –
- Least Expensive Option
- Can be Multi-Purpose
- May be Placed to Limit View Blocking

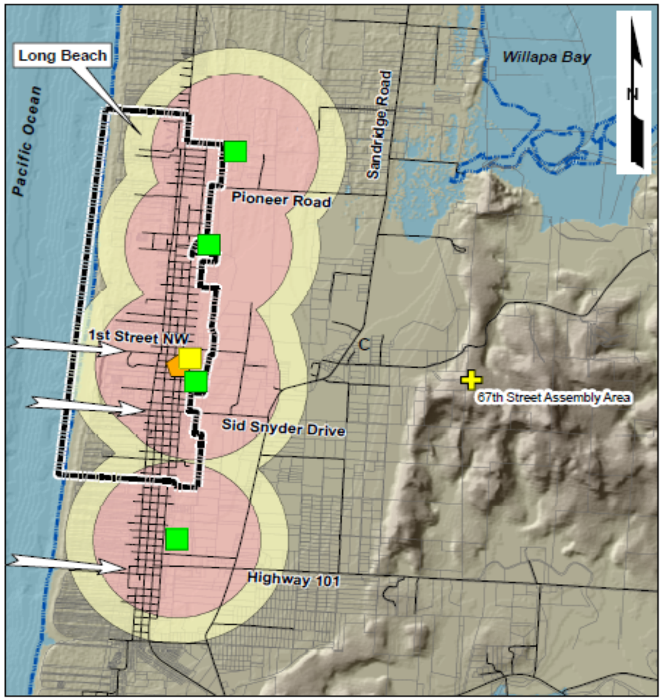
Vertical Evacuation Safe Haven Project

- Community-based, 'bottom-up' approach

- All options (buildings, towers, berms, etc.) are on the table for consideration

Common Themes:
- School Safety
- Seniors and special needs populations
- More conservative travel times

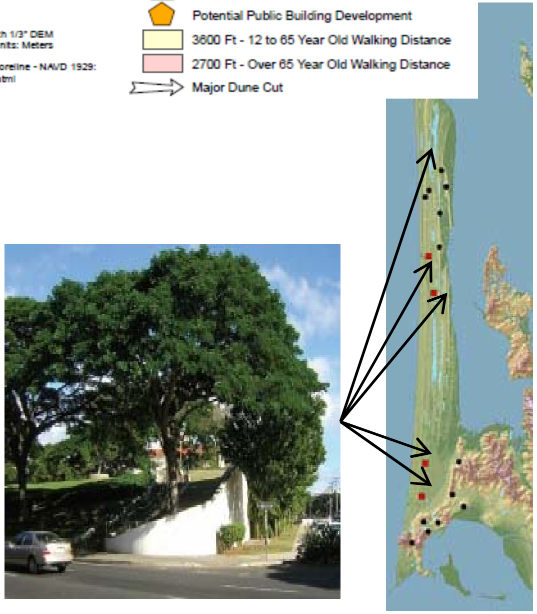
Figure 2 - Preferred Strategy



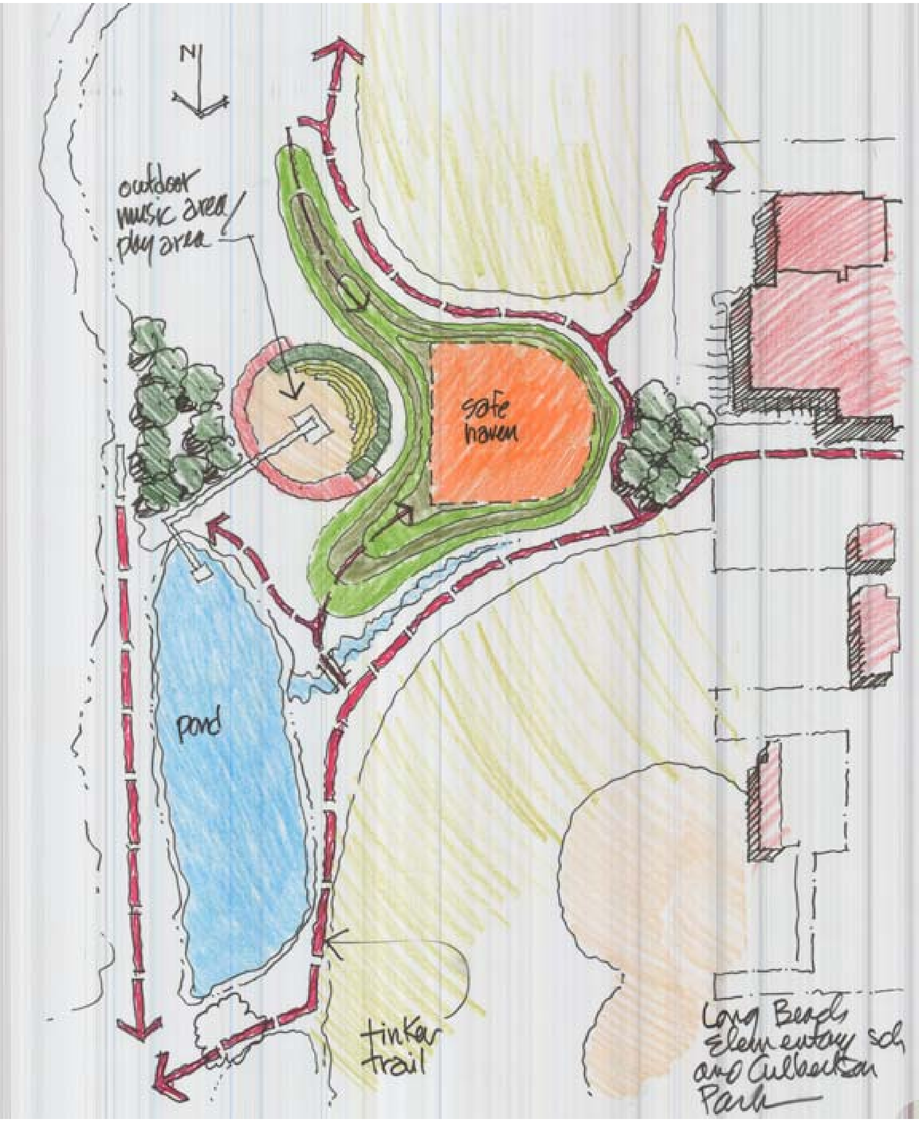
0 3,000 6,000
Approximate Scale in Feet

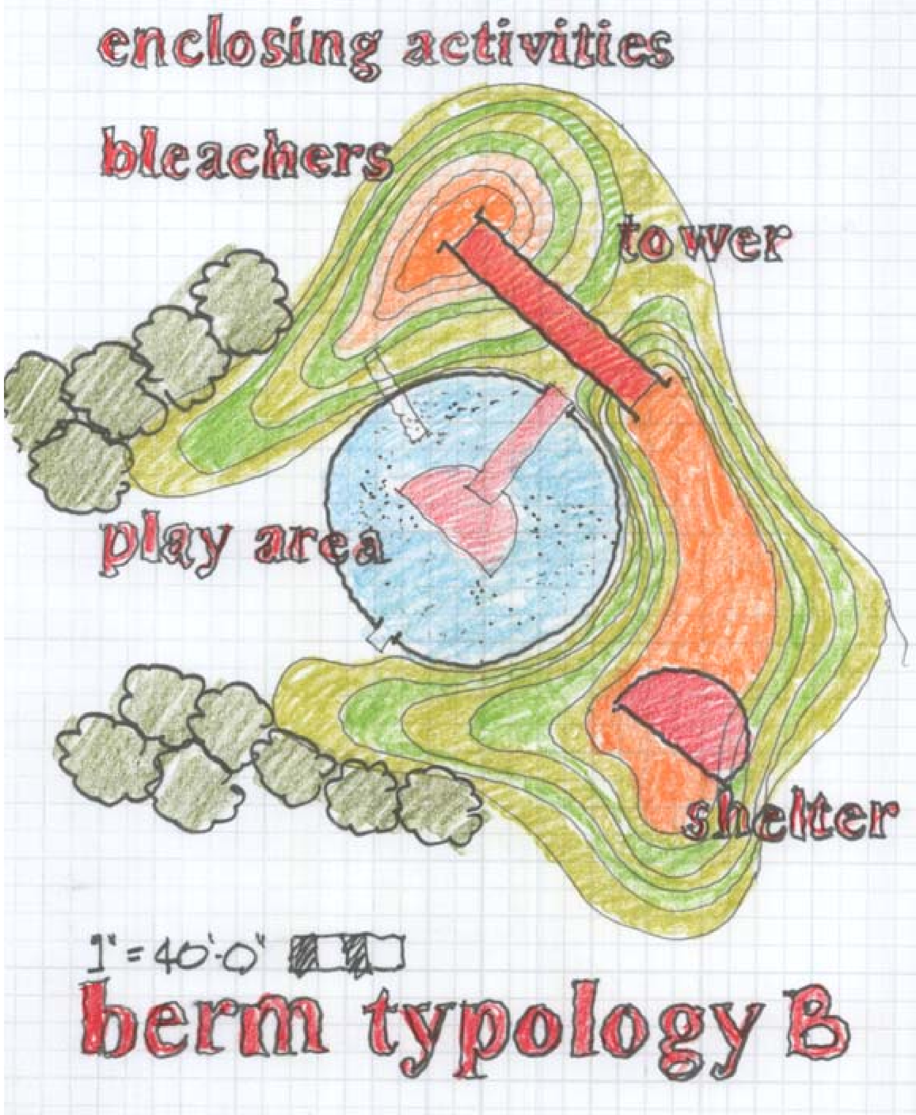
Sources:
NOAA National Center for Tsunami Research 1/3" DEM
Vertical Datum: Mean High Water Vertical Units: Meters
NOAA Medium Resolution Digital Vector Shoreline - NAVD 1929:
http://coastalgeospatial.noaa.gov/data_gis.html

🟨 Potential Bleacher Berm Location
🟩 Potential Berm Location
⬟ Potential Public Building Development
▭ 3600 Ft - 12 to 65 Year Old Walking Distance
▭ 2700 Ft - Over 65 Year Old Walking Distance
⇒ Major Dune Cut

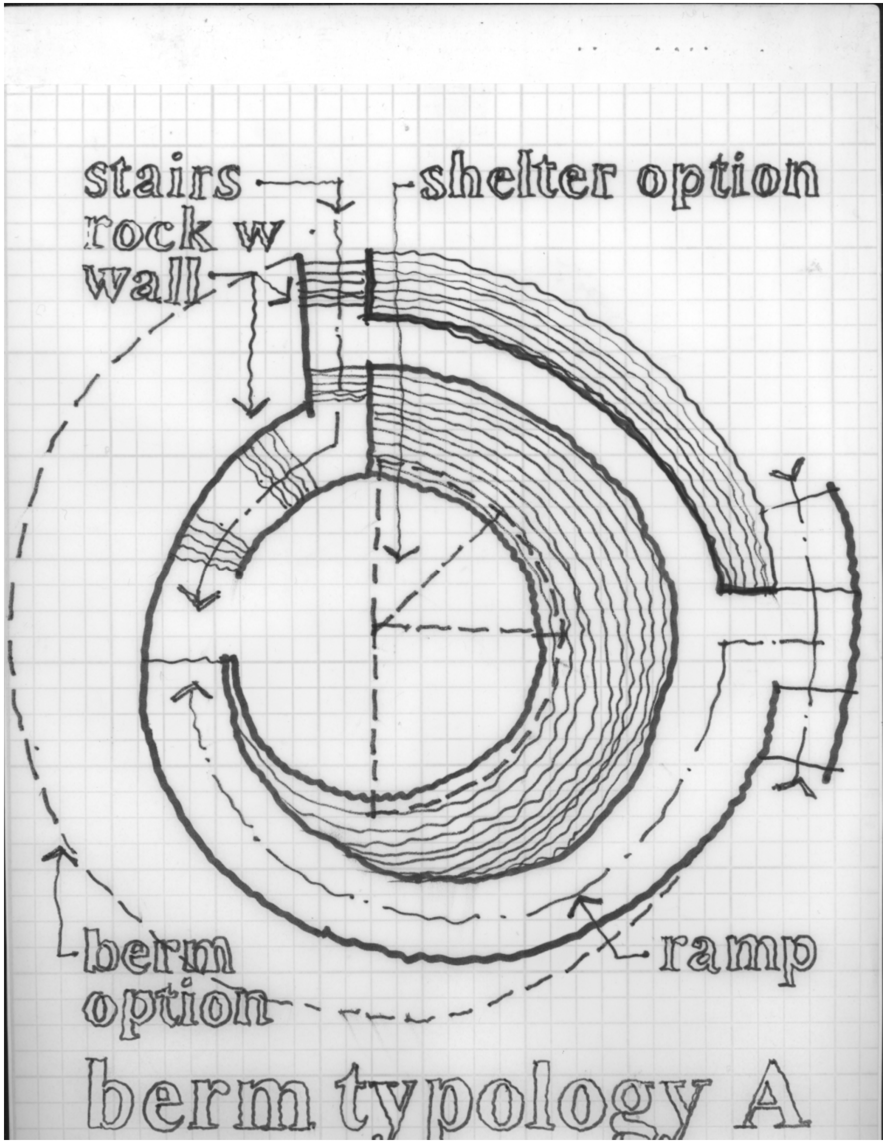


Safe Haven Berms

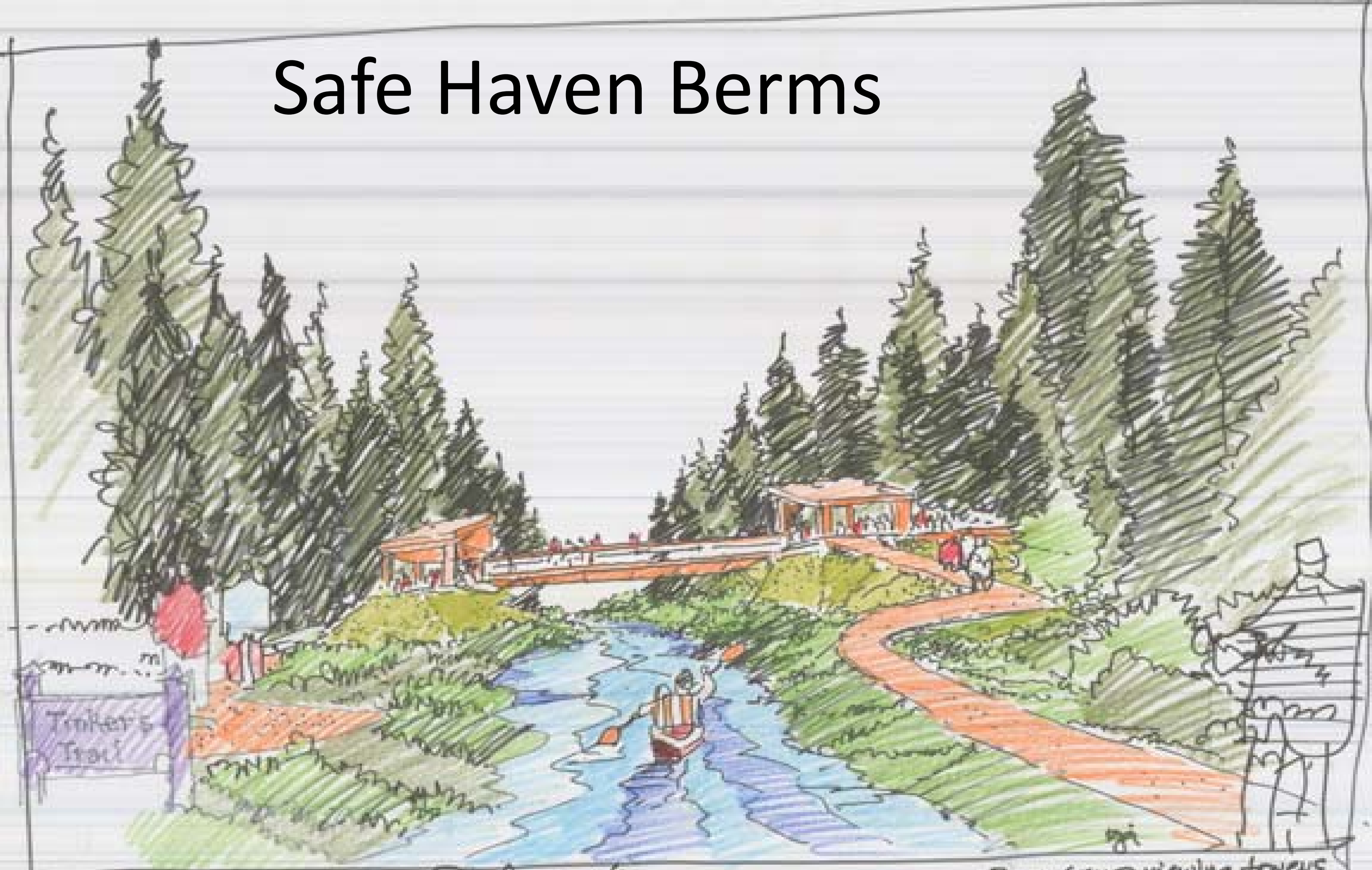

N
outdoor music area/ play area
safe haven
pond
tinker trail
Long Beach Elementary sch and Culbertson Park



Safe Haven Berms



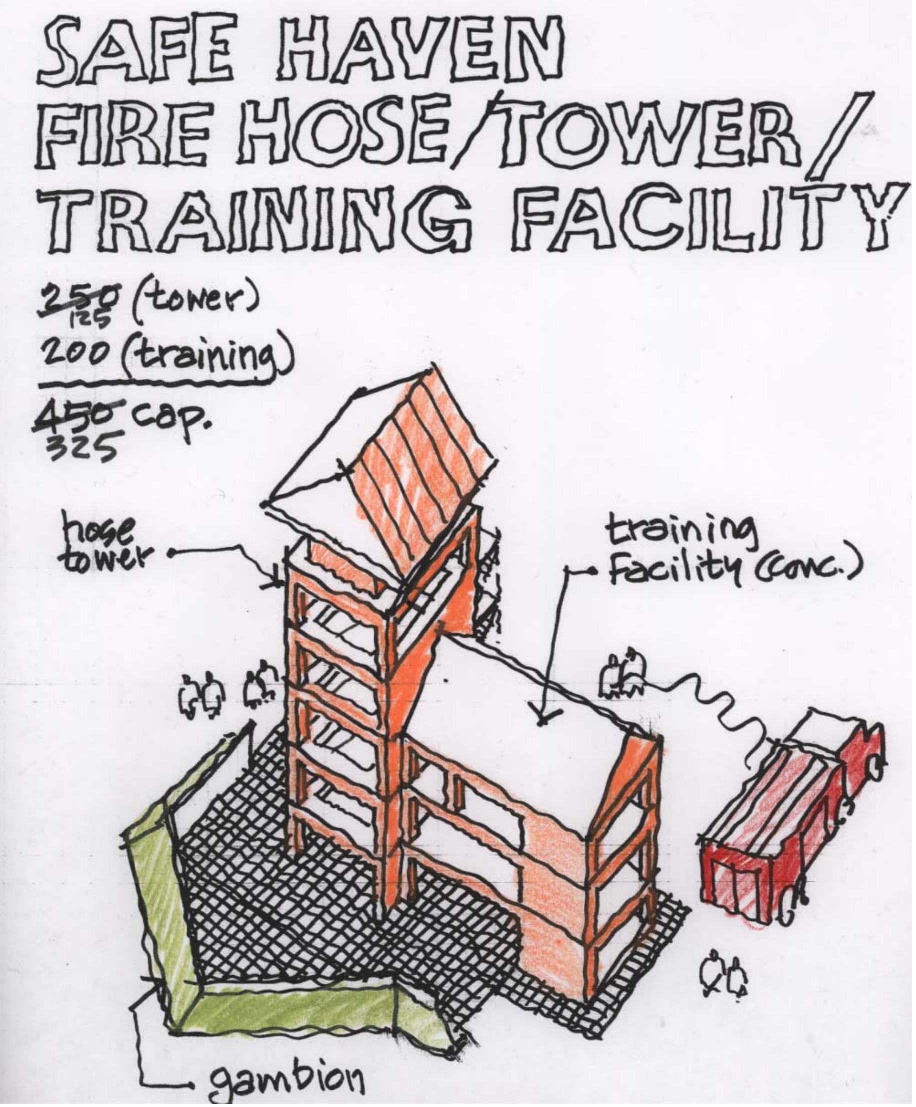
Safe Haven Berms

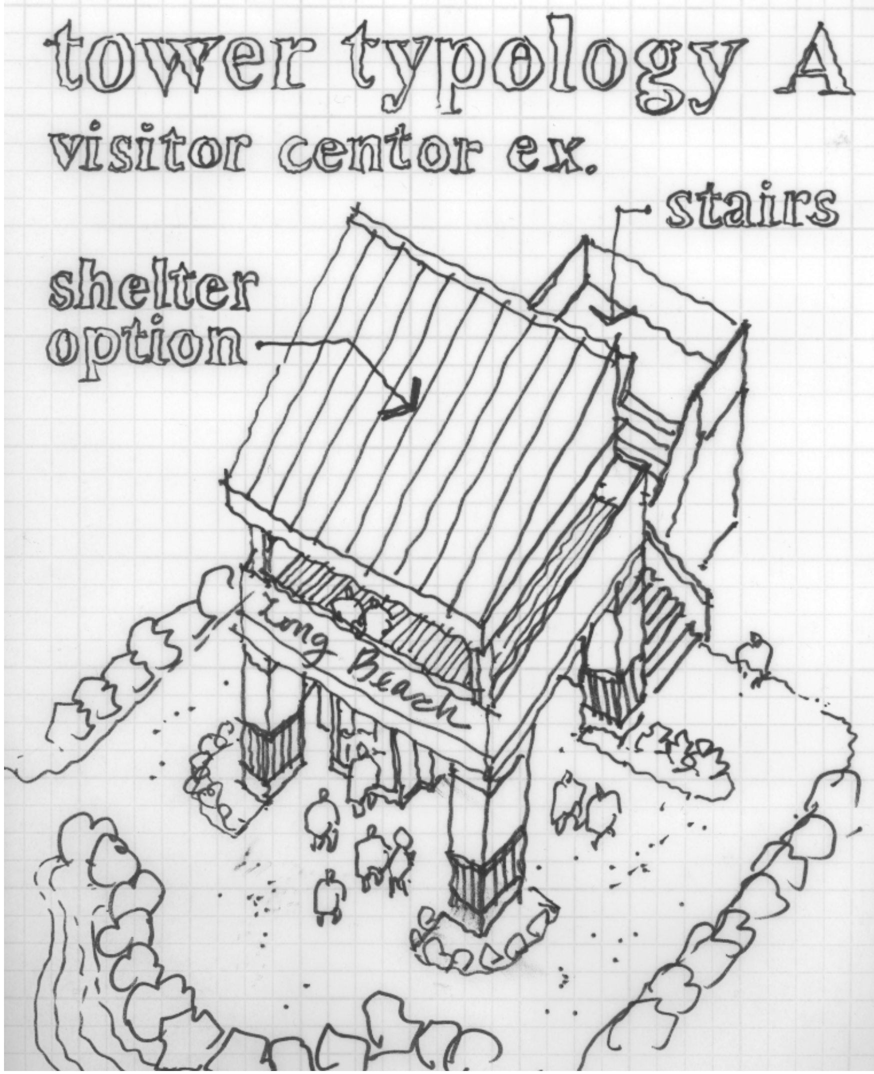


Long Beach Lagoon Park system

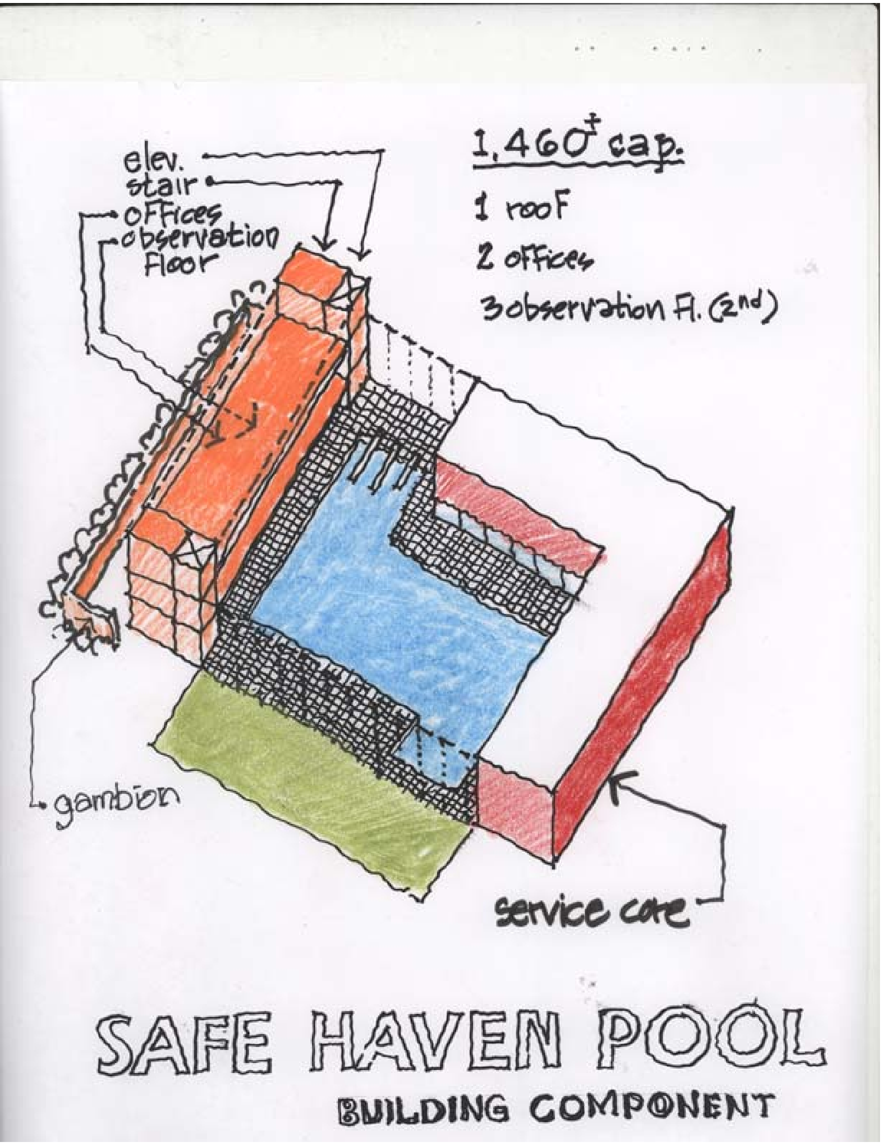
Berm/ramp viewing towers
w/S.H. bridge
100 - 200 people

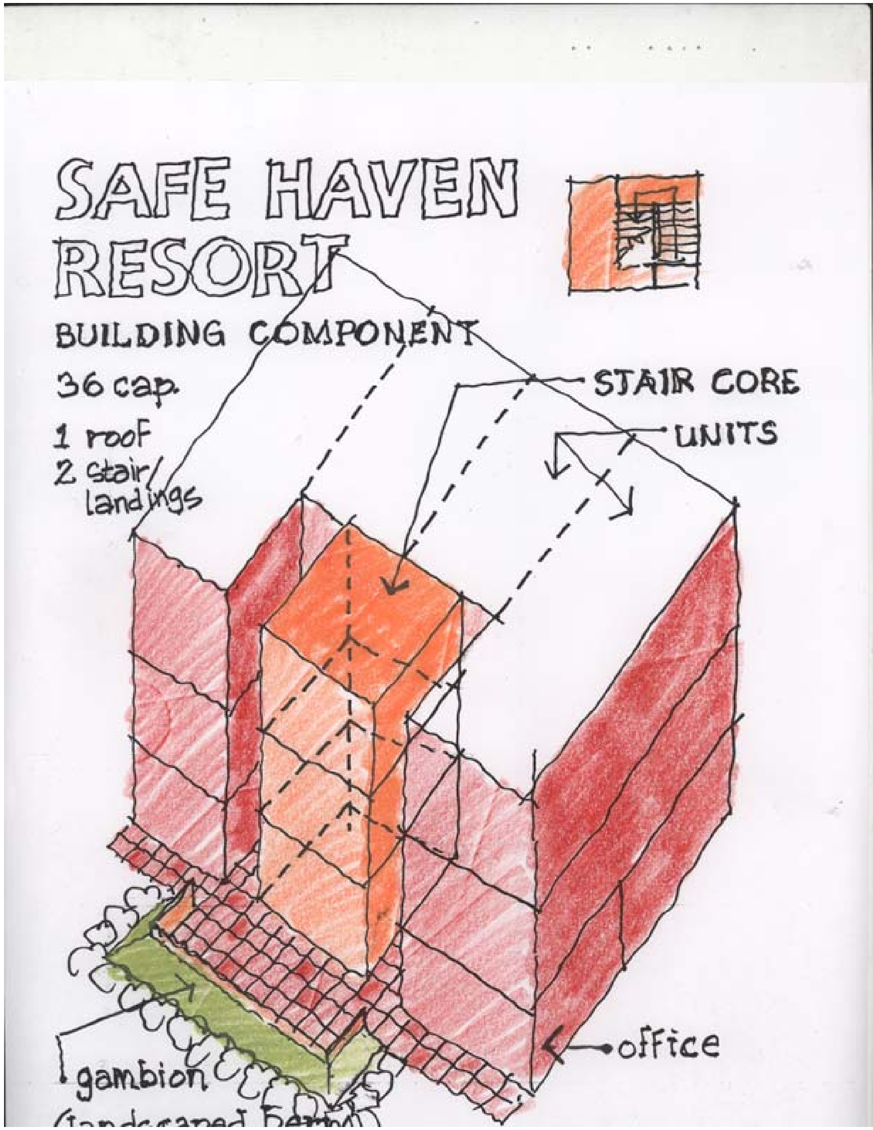
Safe Haven Towers


SAFE HAVEN FIRE HOSE/TOWER/ TRAINING FACILITY
~~250~~ 125 (tower)
200 (training)
~~450~~ 325 cap.
hose tower
training facility (conc.)
gambion



Safe Haven Buildings

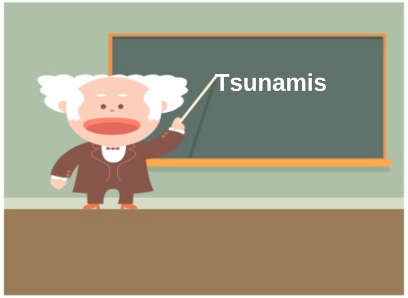




	Type	*Community*	*Site*	*Structure Height (feet)*	*Capacity (# of people)*	*Estimated Cost*
B1	berm	Long Beach	N Place & 41st Place	12	600	$644,095
B2	berm	Long Beach	Washington Avenue South & 5th Street South	9	1000	$706,266
B3	berm	Long Beach	Washington Avenue South & 2nd Street South	12	400	$509,621
B4	berm	Long Beach	13th Street South & Washington Avenue	9	700	$546,830
B5	berm	Long Beach	Q Street (Washington) & 26th Street North	9	500	$440,540
B6	berm	Ocean Park	U Street & 227th Place	9	600	$493,685
B7	berm	Ocean Park	SR 103 & 210th Place	12	200	$375,147
B8	berm	Ocean Park	SR 103 & 188th Place	16	200	$522,162
B9	berm	Ocean Park	SR 103 & 162nd Lane	25	150	$879,152
B10	berm	Ocean Park	SR 103 & Cranberry Road	9	400	$387,394
B11	berm	Ocean Park	U Street & 260th Street	20	800	$1,322,779
B12	berm	Seaview	N Place & 37th Place	12	400	$509,621
B13	berm	Ilwaco	Ortelius Drive & Scarboro Lane North	16	300	$608,188
T1	tower	Tokeland	Kindred Avenue (Nelson Crab)	19	100	$104,218
T2	tower	Tokeland	Tokeland Road & Evergreen Street	19	150	$112,770
T3	tower	Tokeland	Tokeland Road & Pine Lane	19	75	$99,942
T4	tower	North Cove	SR 105 & Whipple Avenue	21	100	$105,929
T5	tower	North Cove	SR 105 & Warrenton Cannery Road	23	100	$107,639
PK1	parking structure	Tokeland	Shoalwater Bay Casino	25	1000	$828,403
PK2	parking structure	Tokeland	Shoalwater Bay Tribal Complex	19	500	$414,201

Train-the-Trainer (T-3) Program

The purpose of the T3 Program is to train a cadre of professionals that are qualified to serve as Tsunami Public Education Instructors at the community level.



- To achieve this, the T3 Program provides participants with a basic understanding of fundamental principles and concepts in:
  - Tsunami Science
  - Tsunami Warning
  - Tsunami Risk Reduction
  - Conducting community-level Tsunami Public Educa
- WA EMD/PMEL/and USGS have conducted two T3 cours rs from 15 cities, counties and tribes participated.
- To date, T-3 graduates have conducted at least 30 comm minimum of 500+ participants.

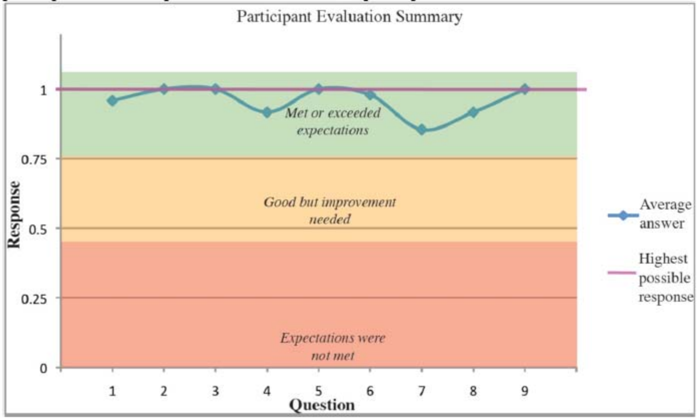
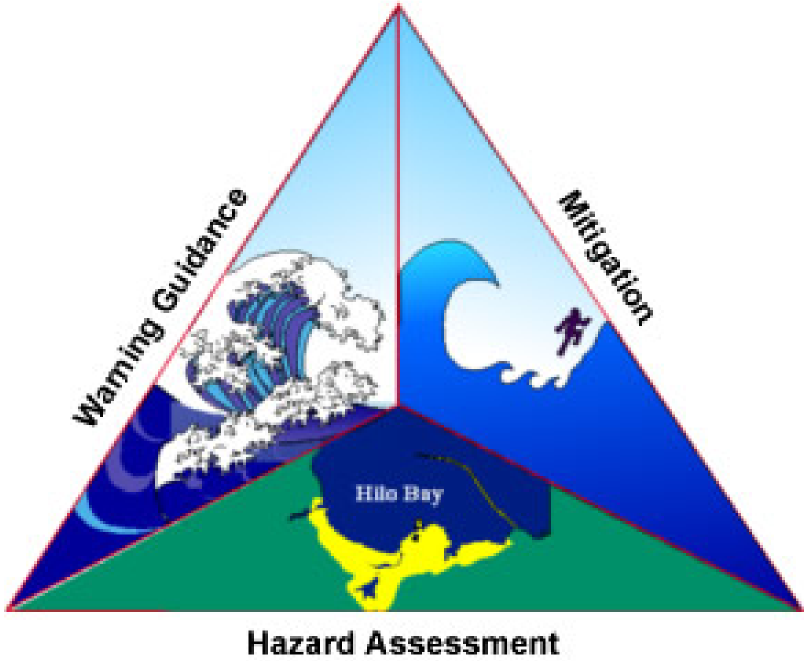

Participant Evaluation Summary
Response
1
0.75
0.5
0.25
0
Met or exceeded expectations
Good but improvement needed
Expectations were not met
1
2
3
4
5
6
7
8
9
Question
Average answer
Highest possible response

Figure 1: Participant evaluation summary

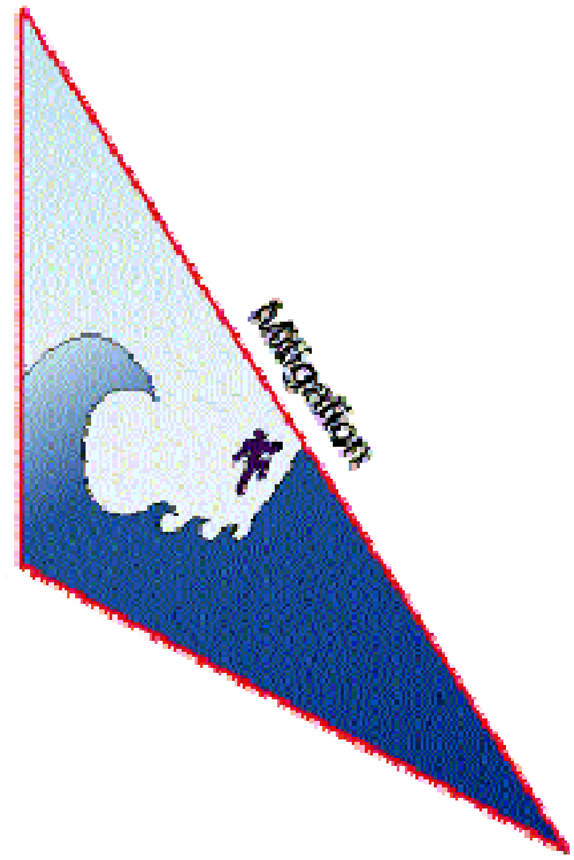
So What Exactly is the National Tsunami Hazard Mitigation Program?

The mission of the NTHMP is to reduce the impact of tsunamis through hazard assessment, warning guidance, and mitigation.



Washington State is a charter member of the National Tsunami Hazard Mitigation Program and structures the state program around these three (3) key functional areas

Tsunami Preparedness & Mitigation



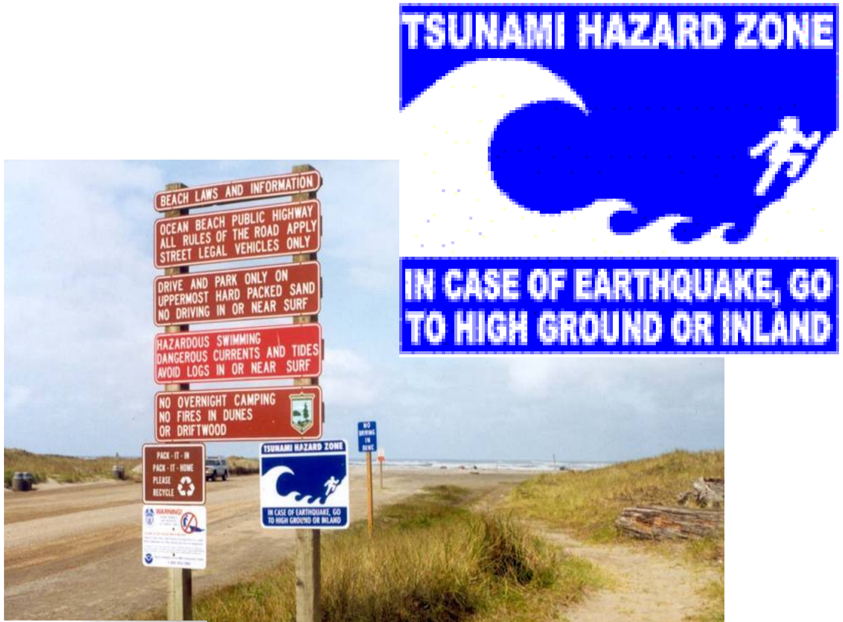
=

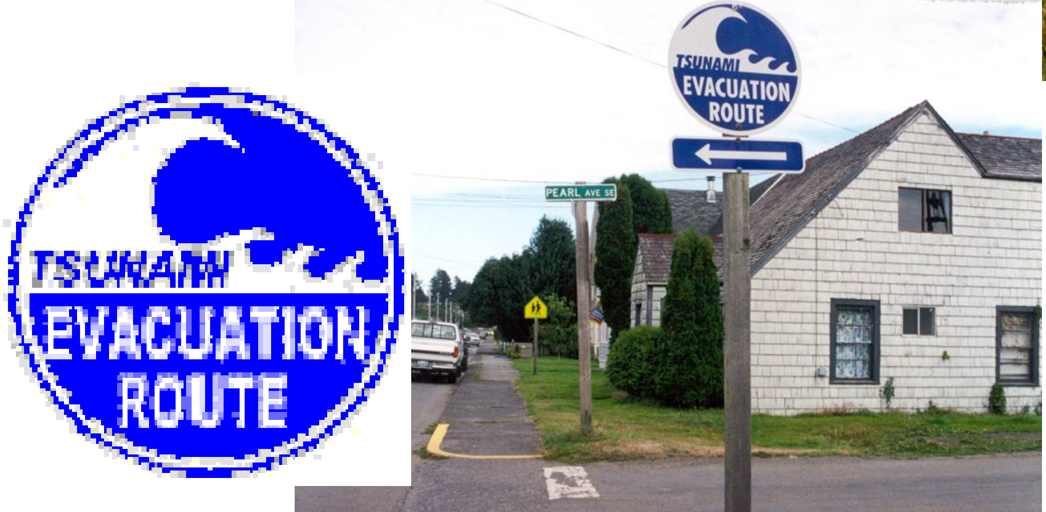
Washington State Tsunami Program:

- Tsunami Signs
- Education
    - Public
    - School
    - Social Science Studies
    - Workshop
- Special Projects

Tsunami Signs

- Pre-event Awareness
- Evacuation Routes
- Consistent Message
- Life Safety Signs


TSUNAMI HAZARD ZONE
IN CASE OF EARTHQUAKE, GO TO HIGH GROUND OR INLAND
BEACH LAWS AND INFORMATION
OCEAN BEACH PUBLIC HIGHWAY ALL RULES OF THE ROAD APPLY STREET LEGAL VEHICLES ONLY
DRIVE AND PARK ONLY ON UPPERMOST HARD PACKED SAND NO DRIVING IN OR NEAR SURF
HAZARDOUS SWIMMING DANGEROUS CURRENTS AND TIDES AVOID LOGS IN OR NEAR SURF
NO OVERNIGHT CAMPING NO FIRES IN DUNES OR DRIFTWOOD
PACK - IT - IN PACK - IT - HOME PLEASE RECYCLE
WARNING!



Hazard Assessment

Hazard Assessment

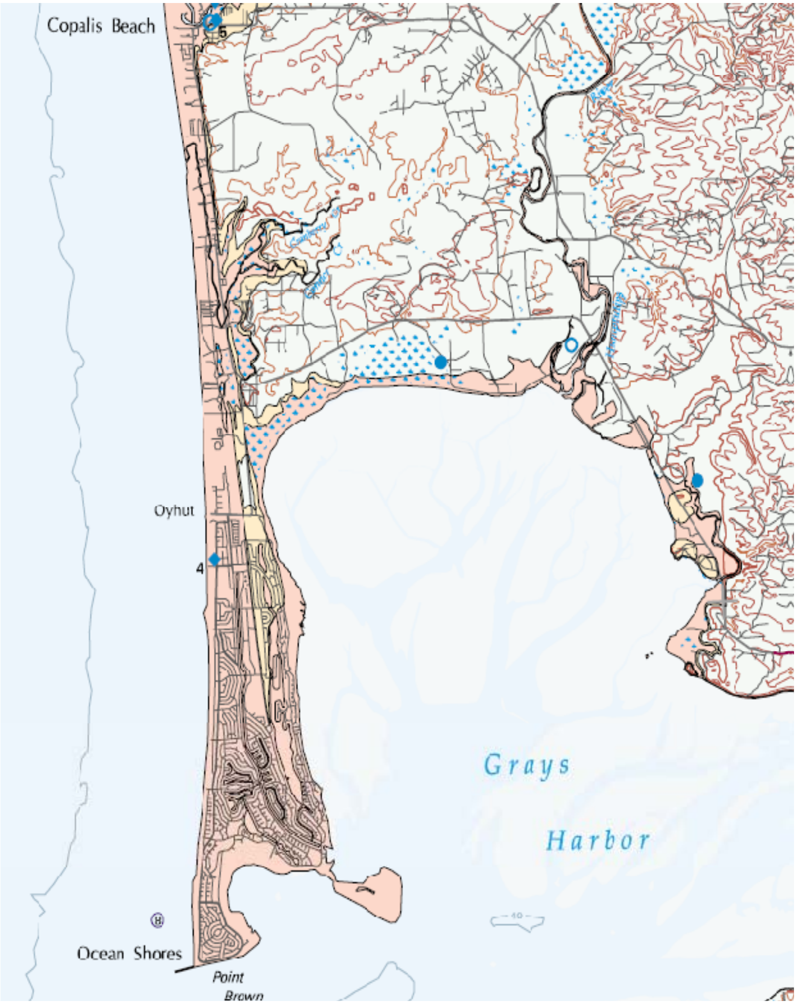
=

Washington State Tsunami Program:

- Scientific Studies and workshop
- Tsunami Modeling
- Inundation Mapping
- Evacuation Mapping

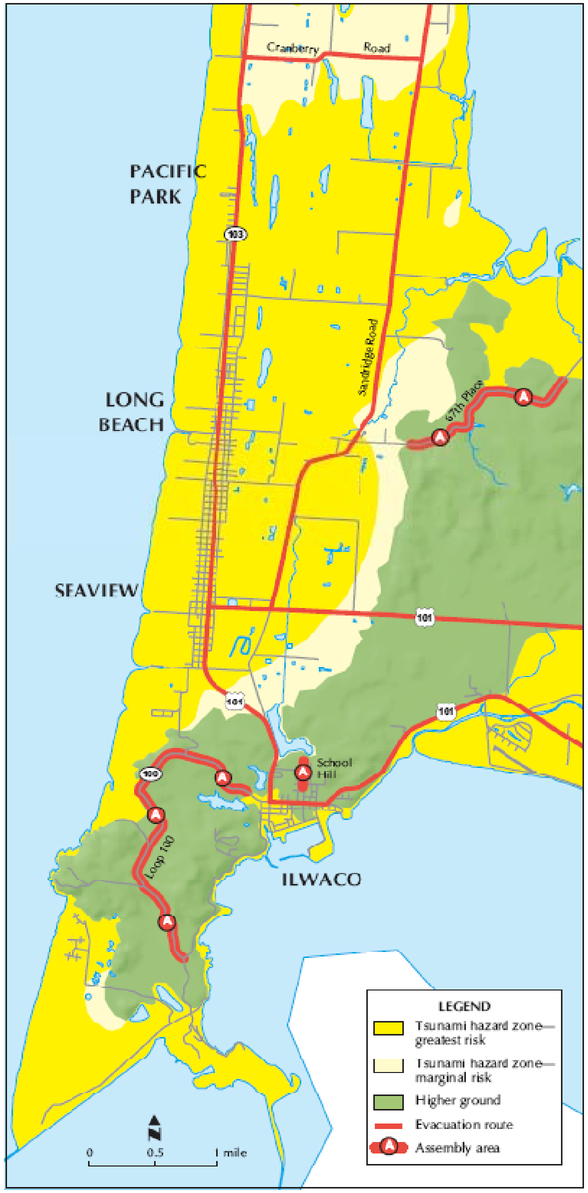
Tsunami Inundation Maps

- Tsunami Inundation Mapping Effort
  - Modeling products to State from NOAA PMEL
  - Workshops with Communities
    - Collect local data & ground truth
  - State Geological Survey develops map
  - Workshops with Communities
    - Product to Jurisdiction



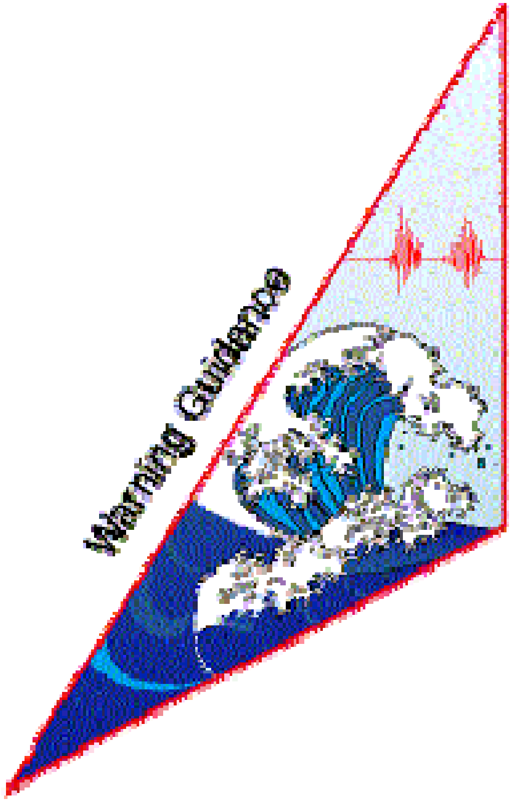
Tsunami Evacuation Maps

- Tsunami Modeling
- Evacuation Maps
- Response Plans



Local tsunami evacuation maps developed based on modeling, maps and local oral history

Warning Guidance



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NOAA:

- Tsunami Detection

Washington State Tsunami Program:

- Alert and Notification

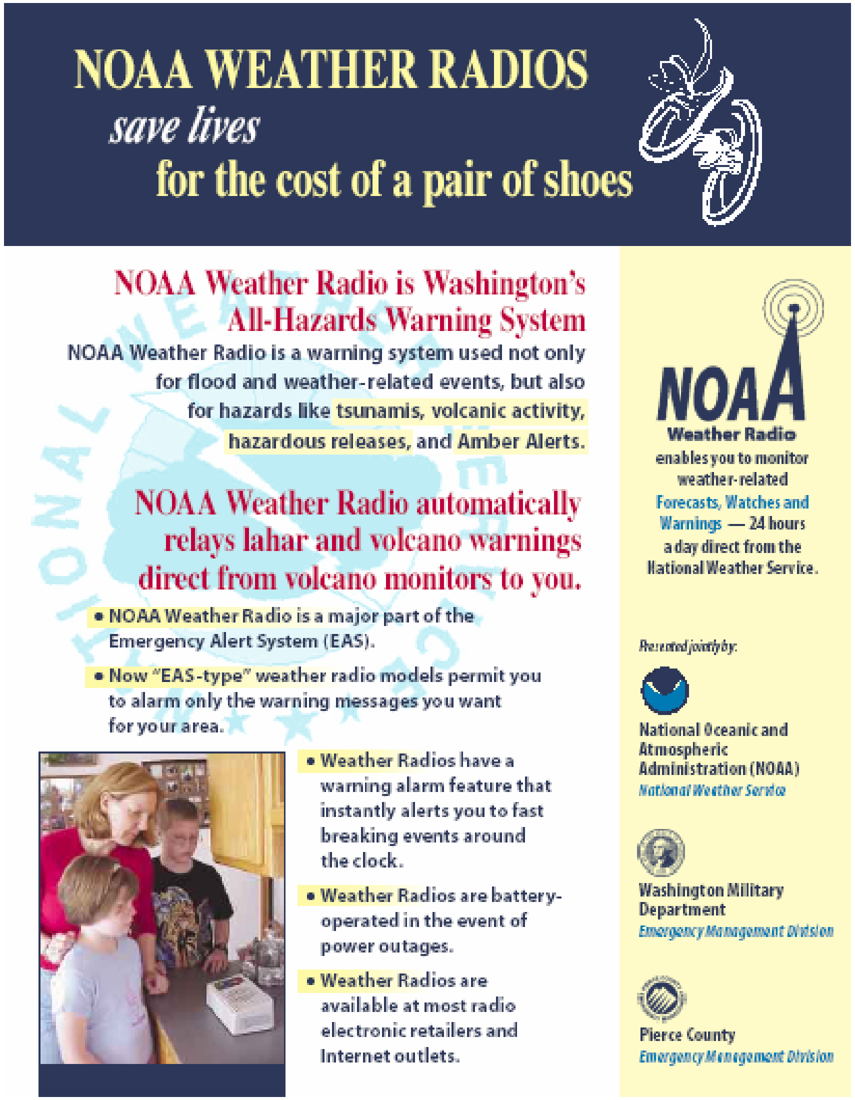
(NOAA, WA EMD, Local Jurisdiction, Media)

Warning Systems & Protocols

- All-Hazards Alert Broadcast (AHAB) Sirens
  - 58 Sirens located along outer coast, Strait of Juan de Fuca, and Puget Sound
  - 4 installations in progress
- Emergency Alert System (EAS)
- NOAA Weather Radios

NOAA Weather Radio

- All-Hazards Warning System
- Part of the Emergency Alert System
- Works in concert with All-Hazard Alert Broadcasting (AHAB) Siren
- Operational in event of local power outages
- Automatically relays warnings directly to you if you have a NOAA Weather Radio



NOAA WEATHER RADIOS
save lives
for the cost of a pair of shoes

NOAA Weather Radio is Washington's All-Hazards Warning System

NOAA Weather Radio is a warning system used not only for flood and weather-related events, but also for hazards like tsunamis, volcanic activity, hazardous releases, and Amber Alerts.

NOAA Weather Radio automatically relays lahar and volcano warnings direct from volcano monitors to you.

- NOAA Weather Radio is a major part of the Emergency Alert System (EAS).
- Now "EAS-type" weather radio models permit you to alarm only the warning messages you want for your area.
- Weather Radios have a warning alarm feature that instantly alerts you to fast breaking events around the clock.
- Weather Radios are battery-operated in the event of power outages.
- Weather Radios are available at most radio electronic retailers and Internet outlets.

NOAA
Weather Radio
enables you to monitor weather-related Forecasts, Watches and Warnings — 24 hours a day direct from the National Weather Service.

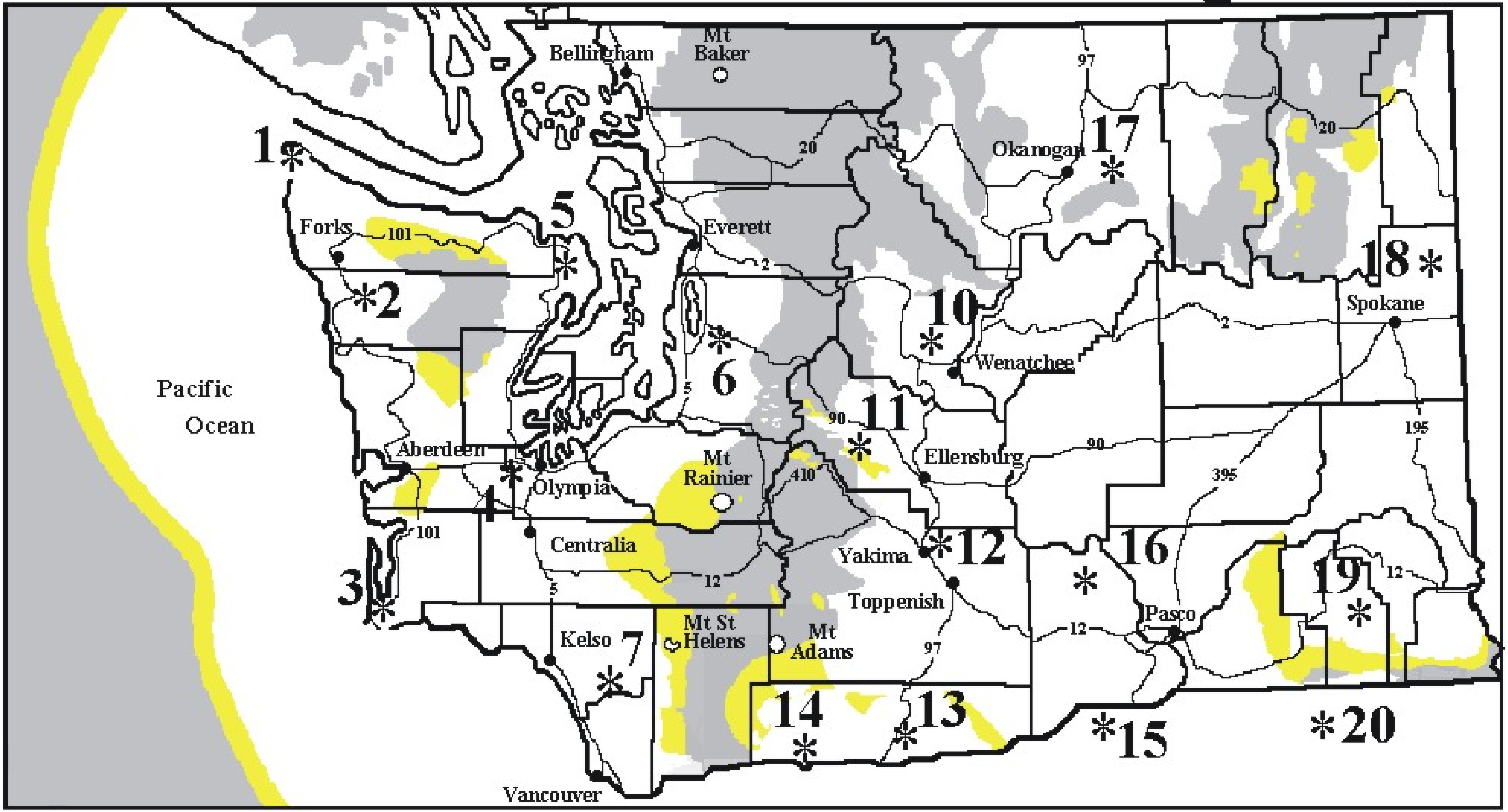
Presented jointly by:

National Oceanic and Atmospheric Administration (NOAA)
National Weather Service

Washington Military Department
Emergency Management Division

Pierce County
Emergency Management Division

NOAA Weather Radio in Washington



☐ Reliable Reception 🟨 Marginal Reception ▩ No Reception

1 - Neah Bay	162.550 MHz
2 - Mt. Octopus	162.425 MHz
3 - Astoria, OR	162.400 MHz
4 - Olympia	162.475 MHz
5 - Puget Sound	162.425 MHz
6 - Seattle	162.550 Mhz
7 - Woodland	162.525 MHz
10 - Wenatchee	162.475 MHz
11 - Cle Elum	162.400 MHz

12 - Yakima	162.550 MHz
13 - Goldendale	162.525 MHz
14 - The Dalles	162.400 MHz
15 - Umatilla, OR	162.500 MHz
16 - Tri-Cities	162.450 MHz
17 - Okanogan	162.400 Mhz
18- Spokane	162.400 MHz
19 - Dayton	162.525 Mhz

20 Pendleton, OR	162.400 MHz
Additional Sites (not shown):	
-Aldergrove, BC	162.550 MHz
-Bonners Ferry, ID	162.500 MHz
-Lewiston, ID	162.550 MHz
-Portland, OR	162.550 MHz
-Vancouver, BC	162.400 MHz
-Victoria, BC	162.475 MHz

All-Hazard Alert Broadcasting (AHAB) Siren

- Federal-State-Local Partnership
  - Population Centers
  - Primarily Located Along Outer Coast and Strait of Juan de Fuca
- Modulator siren – 360 Degree
  - Digital Voice Capability
  - Can be used as a 4500 watt PA
- Redundant System- Can be activated by :
  - 24/7 State EOC
  - Local Emergency Management

Washington State All-Hazard Alert Broadcasting (AHAB) Network

Operational (58)

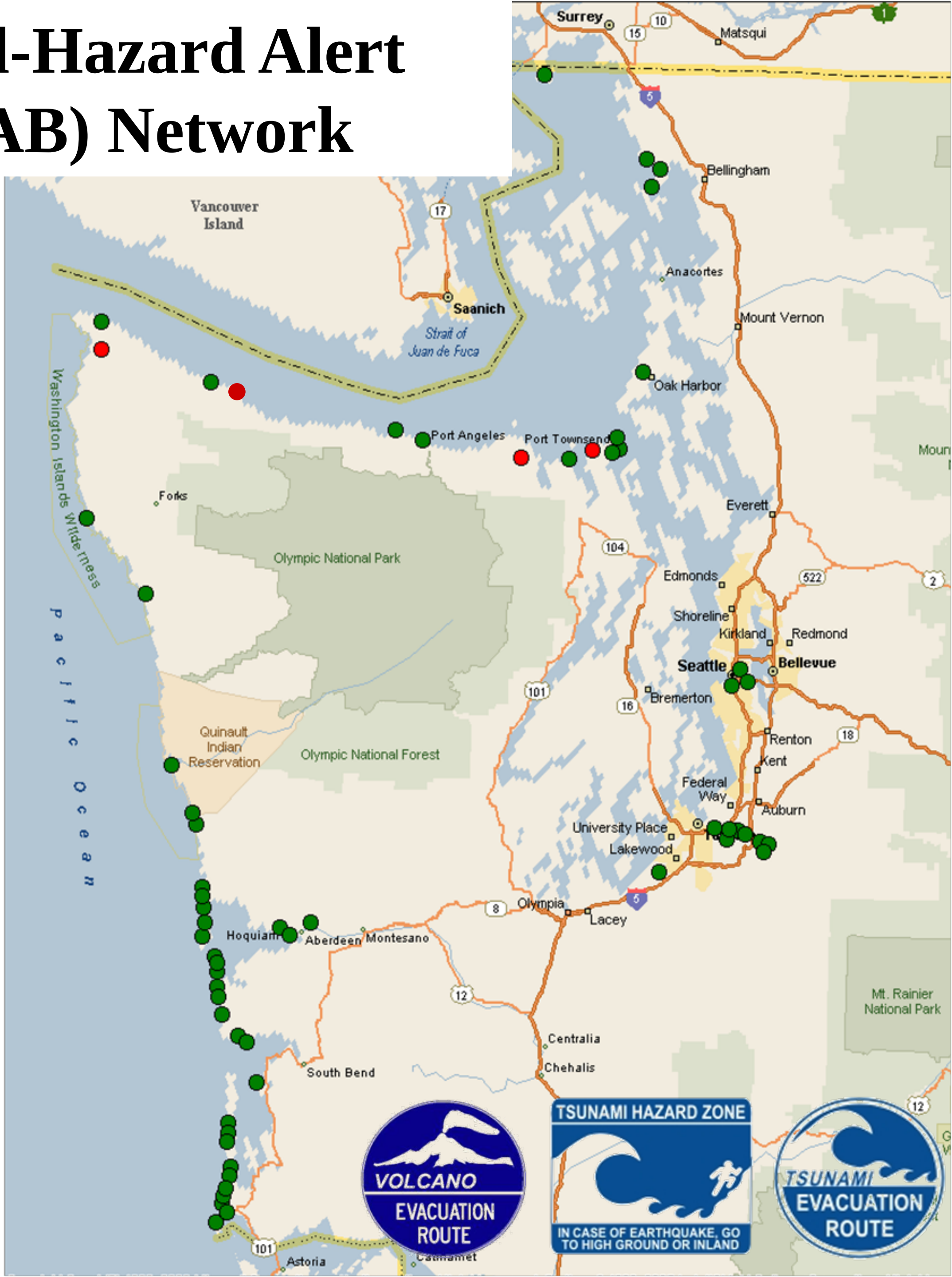
- Aberdeen (2)
- Bay Center
- Cape Disappointment
- Copalis Beach
- Diamond Point
- Fort Worden
- Grayland (3)
- Hoh Tribe
- Hoquiam
- Ilwaco
- Island County
- La Push (Quileute Tribe)
- Long Beach
- Lower Elwha
- Lummi Nation (2)
- McAlder
- McMillin
- Moclips
- Neah Bay
- North Cove
- Ocean City
- Ocean Park (4)
- Ocean Shores (4)
- Orting (3)
- Puyallup (2)
- Pacific Beach
- Pacific Park
- Point Roberts
- Port Angeles
- Port Townsend (2)
- Sandy Point
- Seattle (3)
- Seaview
- Sumner
- Surfside
- Taholah (Quinault Nation)
- Shoalwater Bay Tribe (2)
- Westport (3)
- Camp Murray (Controller)

In Progress (4)

- Makah Tribe
- Pt. Townsend-N. Beach
- Sequim
- Seiku/Clallam Bay

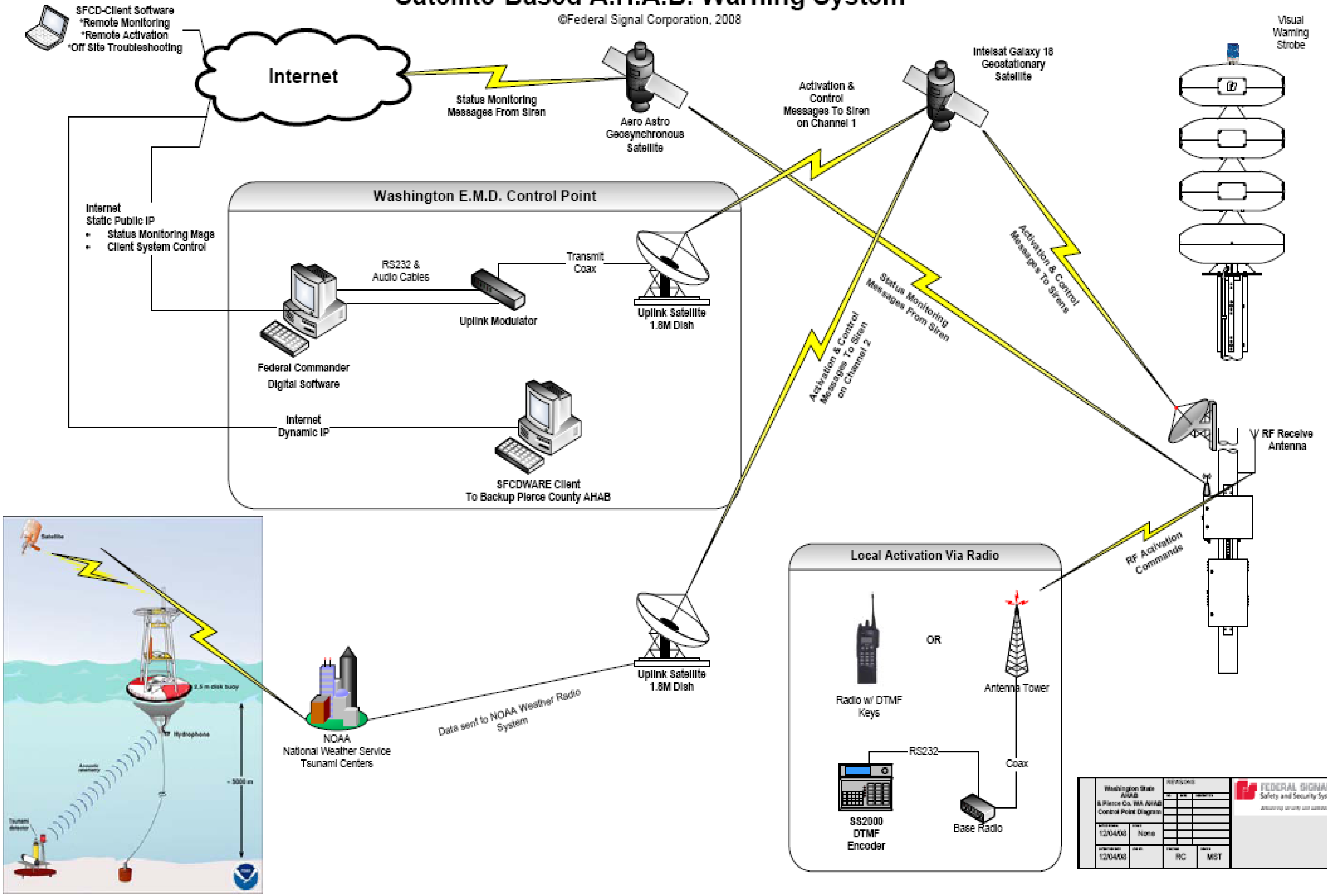
- **96 AHABs needed along outer coast for effective tsunami warning**
- **47 of 58 are satellite linked**

- **Current: 50 tsunami, 8 volcano**



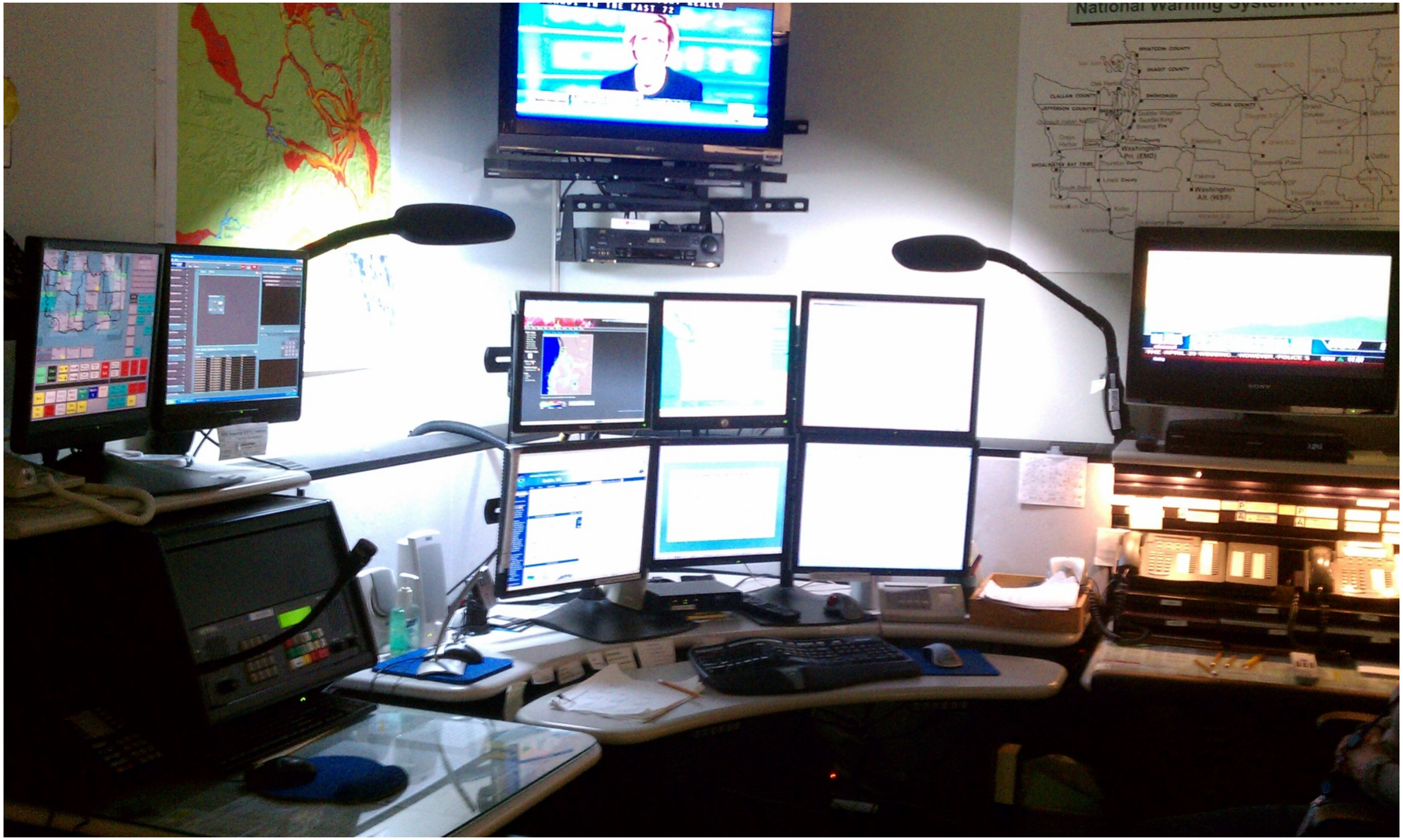
Washington State Emergency Management Division
Satellite-Based A.H.A.B. Warning System

©Federal Signal Corporation, 2008

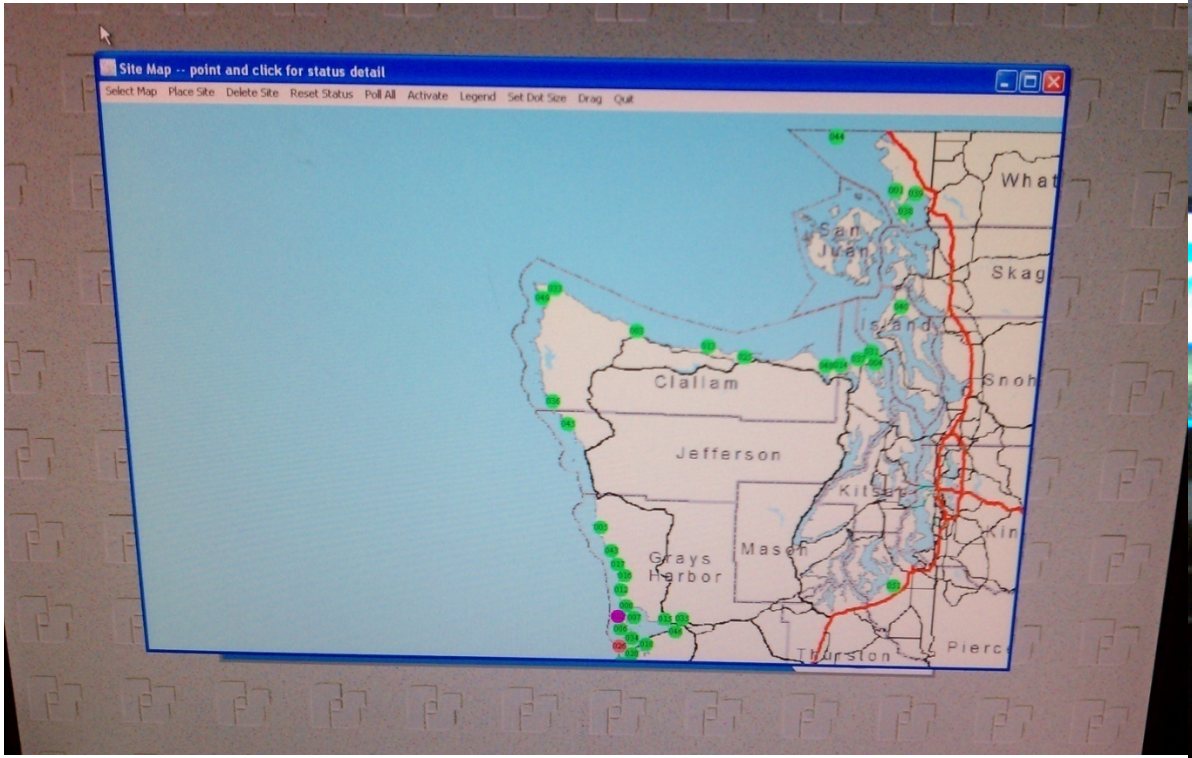

SFCD-Client Software
*Remote Monitoring
*Remote Activation
*Off Site Troubleshooting
Internet
Status Monitoring Messages From Siren
Aero Astro Geosynchronous Satellite
Activation & Control Messages To Siren on Channel 1
Intelsat Galaxy 18 Geostationary Satellite
Visual Warning Strobe
Internet
Static Public IP
• Status Monitoring Msgs
• Client System Control
Washington E.M.D. Control Point
RS232 & Audio Cables
Transmit Coax
Uplink Modulator
Uplink Satellite 1.8M Dish
Federal Commander Digital Software
Internet Dynamic IP
SFCDWARE Client To Backup Pierce County AHAB
Activation & Control Messages To Sirens
Status Monitoring Messages From Siren
Activation & Control Messages To Siren on Channel 2
RF Receive Antenna
RF Activation Commands
Satellite
2.5 m disk buoy
Hydrophone
Acoustic telemetry
~ 5000 m
Tsunami detector
NOAA National Weather Service Tsunami Centers
Data sent to NOAA Weather Radio System
Uplink Satellite 1.8M Dish
Local Activation Via Radio
Radio w/ DTMF Keys
OR
Antenna Tower
RS232
Coax
SS2000 DTMF Encoder
Base Radio
Washington State AHAB & Pierce Co. WA AHAB Control Point Diagram
REVISIONS
12/04/08
None
12/04/08
RC
MST
FEDERAL SIGNA
Safety and Security Sy

Drawing from NOAA.GOV

Duty Officer Station

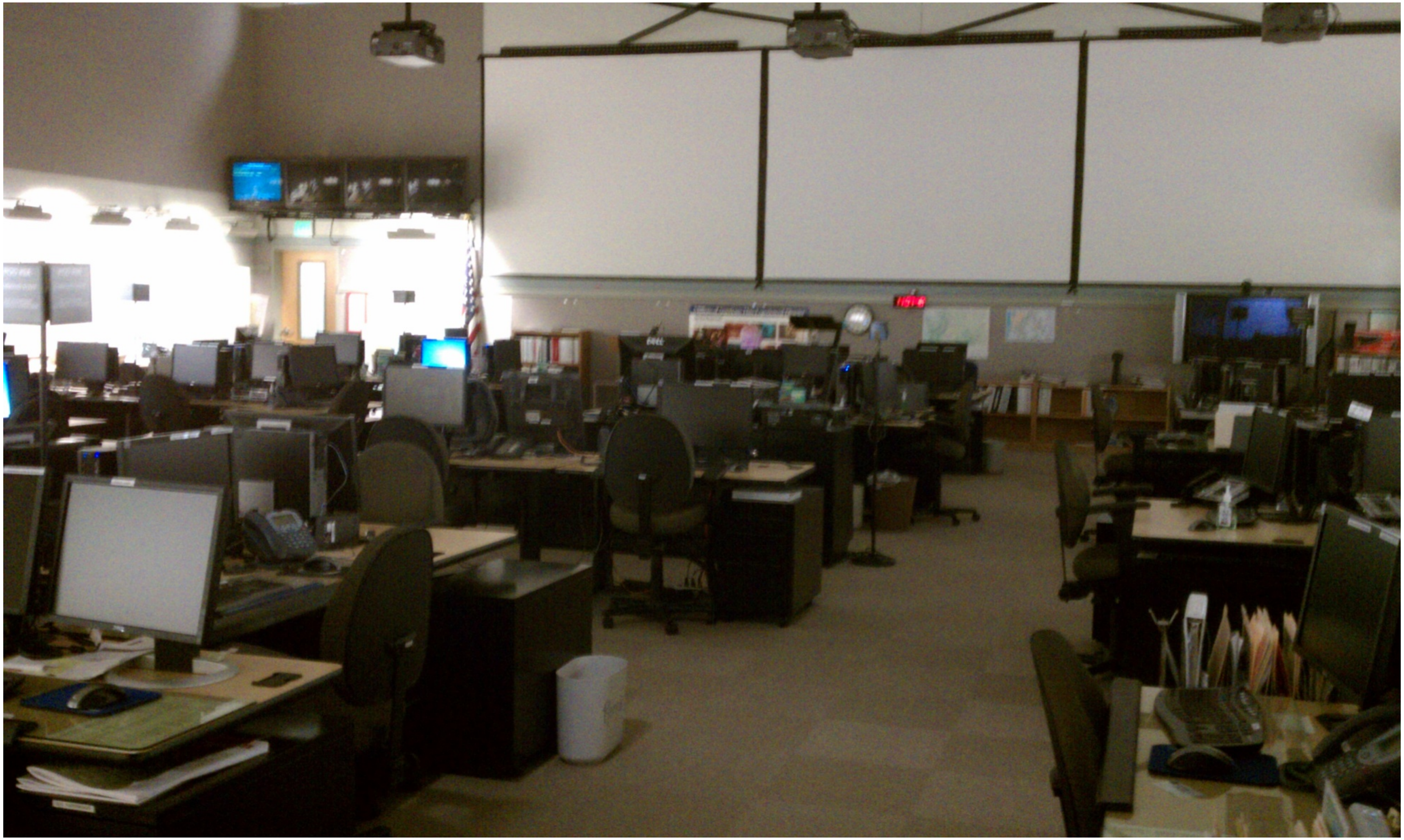


AHAB & EAS


Site Map -- point and click for status detail
Select Map
Place Site
Delete Site
Reset Status
Poll All
Activate
Legend
Set Dot Size
Drag
Quit
What
San Juan
Skag
Island
Snoh
Clallam
Jefferson
Kitsap
Grays Harbor
Mason
Kin
Thurston
Pierc

WSI

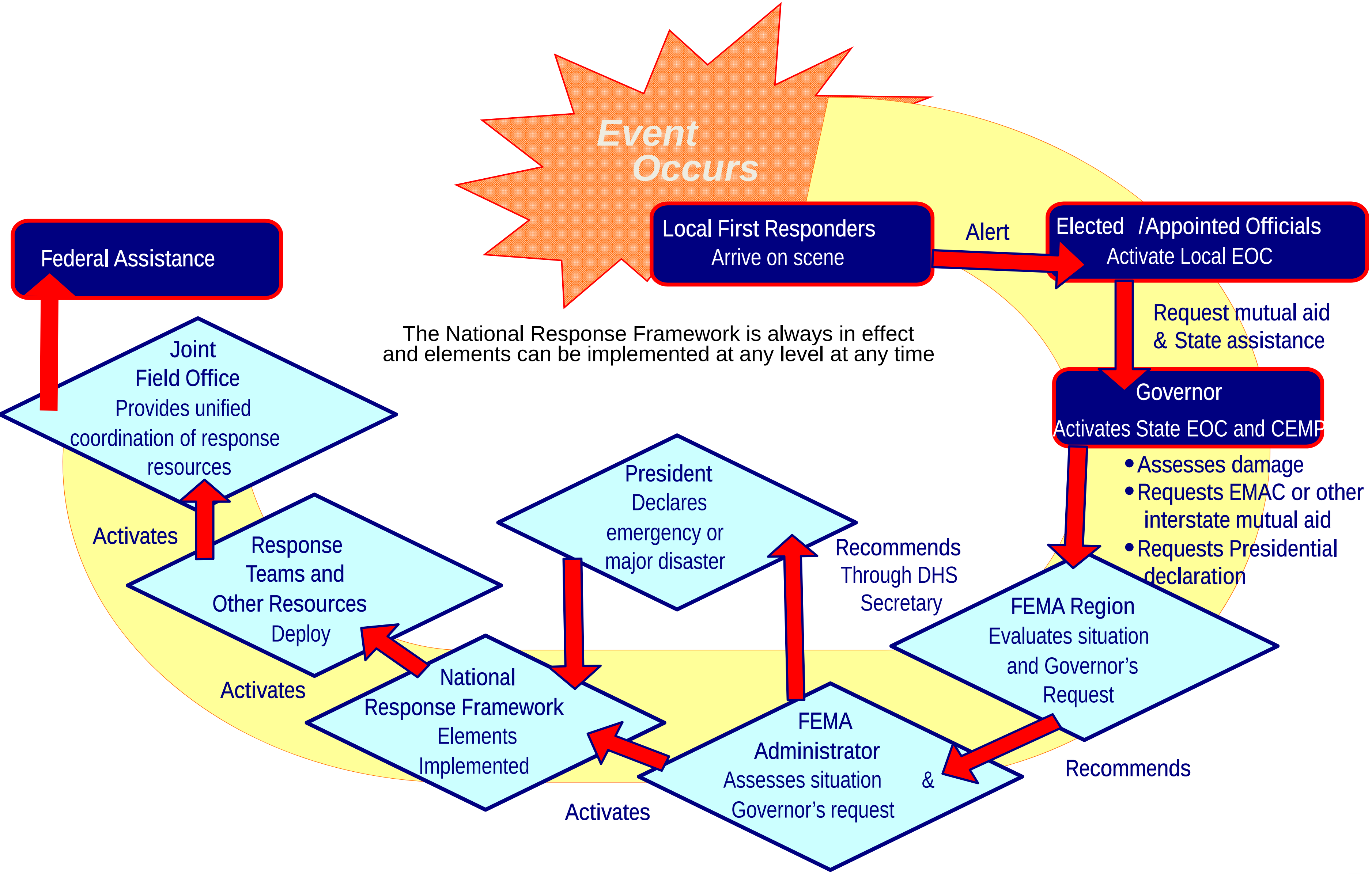
Emergency Operations Center



Current Program Priorities\Projects

- Continued focus on innovation and Public-Private Partnerships
    - On-Star Partnerships
- Tsunami Evacuation
    - Private Land Agreements
    - Vertical Evacuation Studies & Structures
- Evaluation and Expansion of AHAB Warning System
- Continued Modeling & Mapping of Coastal Areas
- NOAA Weather Radios for Low Income/Special Needs Populations
- Increase the Number of TsunamiReady Communities

Federal/State/Local Earthquake Response



Event Occurs

Local First Responders
Arrive on scene

Alert

Elected /Appointed Officials
Activate Local EOC

Request mutual aid
& State assistance

Governor
Activates State EOC and CEMP

- Assesses damage
- Requests EMAC or other interstate mutual aid
- Requests Presidential declaration

FEMA Region
Evaluates situation
and Governor's
Request

Recommends

FEMA
Administrator
Assesses situation &
Governor's request

Recommends
Through DHS
Secretary

President
Declares
emergency or
major disaster

Activates

National
Response Framework
Elements
Implemented

Activates

Response
Teams and
Other Resources
Deploy

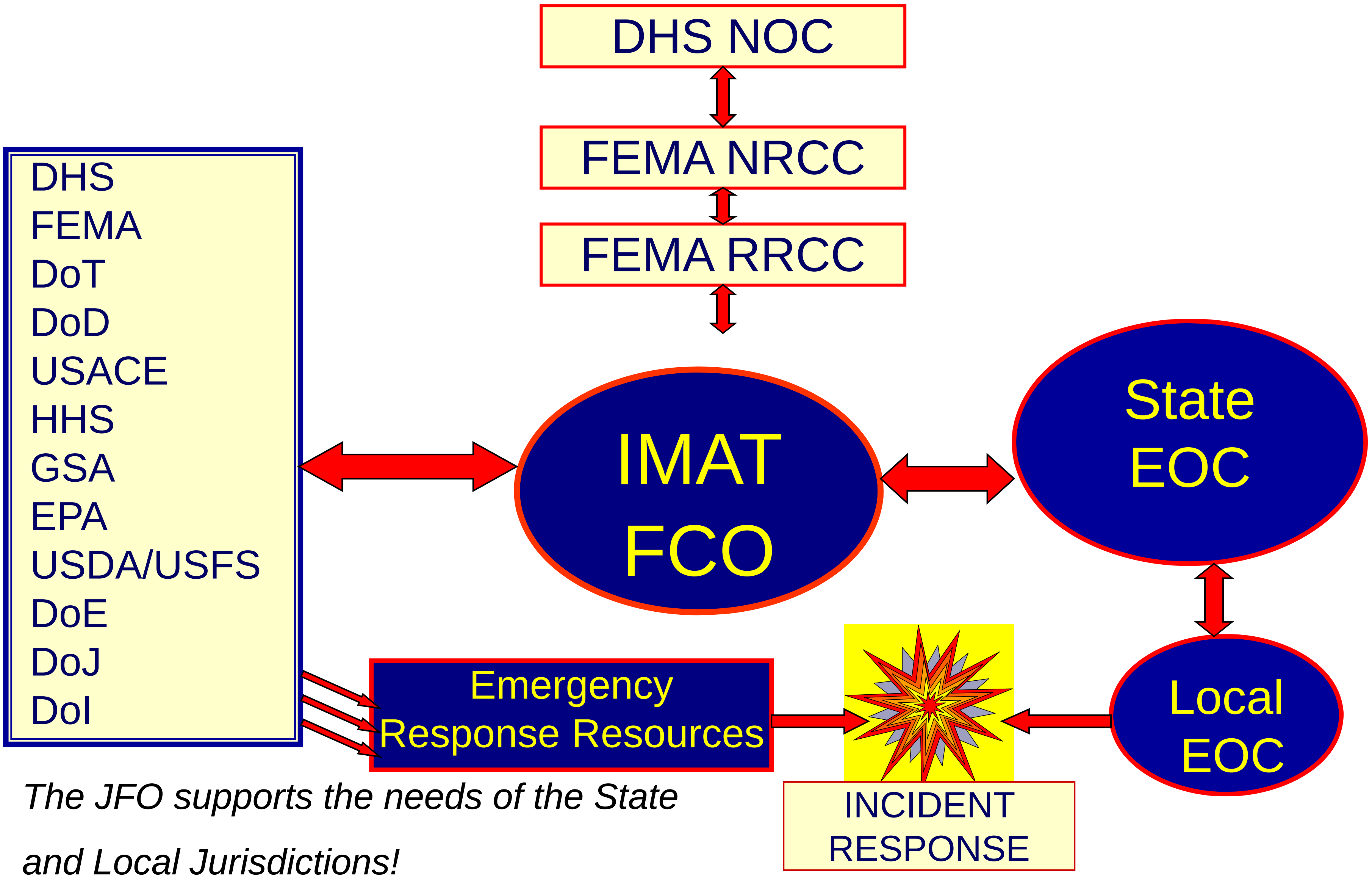
Activates

Joint
Field Office
Provides unified
coordination of response
resources

Federal Assistance

The National Response Framework is always in effect
and elements can be implemented at any level at any time

Federal/State/Local Response
(aka Alphabet Soup)



DHS NOC

FEMA NRCC

FEMA RRCC

DHS
FEMA
DoT
DoD
USACE
HHS
GSA
EPA
USDA/USFS
DoE
DoJ
DoI

IMAT
FCO

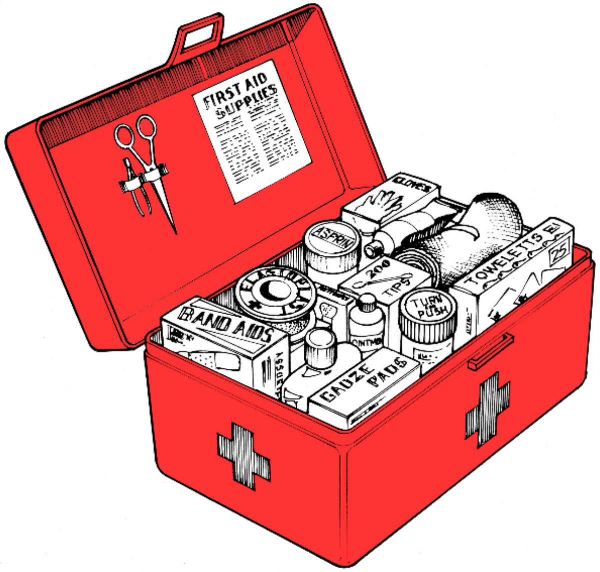
State
EOC

Emergency Response Resources

INCIDENT RESPONSE

Local
EOC

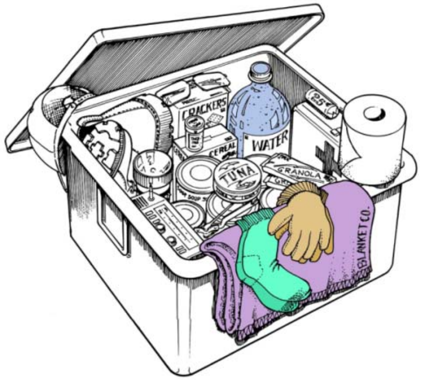
The JFO supports the needs of the State and Local Jurisdictions!



SO THAT’S WHAT WE’RE DOING TO BE PREPARED…

WHAT ARE YOU DOING???

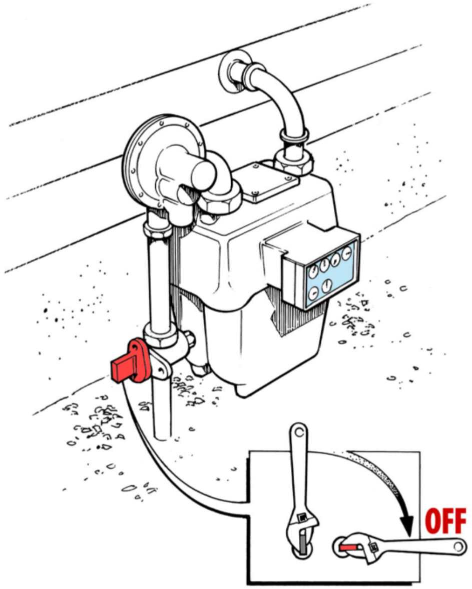
Personal Preparedness



- Have a Plan and Practice it!
- Establish an Out of Area Contact
- Make a Kit:
  - *Water* – At least three (3) gallons for each person
  - *Food* – Canned goods, energy bars, comfort foods
  - *First Aid Kit* – Gauze pads, bandages, adhesive tape, etc.
  - *Tools and Supplies* – Radio, fire extinguisher, whistle, toilet paper, duct tape, flashlights and batteries
  - *Special Items* – Extra eye glasses, medications, baby supplies, clothing and bedding

Personal Preparedness

- Make copies of Important Documents
  - Insurance, Financial Statements, etc.
- Keep Items Under the Bed
  - Sturdy shoes, work gloves, hard hat, flashlight, OK Card for Map Your Neighborhood
- Know how to shut off utilities
- Practice Drop, Cover, and Hold
  - **NOT** THE TRIANGLE OF LIFE!!!!



Preparedness is a Team Effort…

Private Sector and Non-Profit Organizations

USGS
science for a changing world

FEMA

Washington Military Department
Emergency Management Division

WASHINGTON STATE
Seismic Safety Committee
Emergency Management Council

Local Jurisdictions & Tribes

YOU

PNSN

WASHINGTON STATE DEPARTMENT OF
Natural Resources

But in the end we all have a role to play!

Thank You!

Questions?

- **www.dnr.wa.gov**
- **www.emd.wa.gov**